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The value of risk management in a young startup



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Program:
Accounting and financial management
Supervisor:
Stefan Sjögren

Authors:
Erik Holmberg
930307
Jacob Lejdborg
941024

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Abstract

We have performed a case study of a young venture capital backed startup based in Sweden. By having full access to the company's management and insight into all internally gathered data and projections, we have had a unique opportunity to gain deeper understanding of how the entrepreneurs of the case company manage risk and uncertainty within their business. To find out what value these practices add to the company, real option valuations were conducted where the company was valued with and without risk management. Our findings go against previous literature, which states that entrepreneurs are risk lovers who knowingly and willfully embrace risk taking. Instead, we found that the entrepreneurs are diligently managing both risk and uncertainty by dividing all internal projects into two-week "sprints", where the performance of each project is continually evaluated and monitored to minimize the risk of spending time and money on unsuccessful ideas. Furthermore, our valuations indicate that the risk management practice of the case company may increase its value with a factor of 4.17x.

Keywords: *Risk, Uncertainty, Entrepreneur, Risk Propensity, Real Option Analysis, Real Option Lens*

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Erik Holmberg

Jacob Lejdborg

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1. Introduction

In this chapter, we provide some background to the studied topic and describe the purpose of the study, as well as what questions we wish to answer in this report.

There has been extensive research on how Venture Capital (VC) firms handle risk and the effects of this on a macro level, but it is fundamental to understand how the entrepreneurs themselves handle and manage risk and uncertainty. However, according to the literature (e.g. Liu & Almor, 2016; Burns, Barney, Angus & Herrick, 2016; Packard, Clark & Klein, 2017; Nguyen-Duc, Dahle, Steinert, & Abrahamsson, 2017) there seem to be a lack of insight into the minds of entrepreneurs and how they approach and manage the risk and uncertainty they face when establishing businesses.

While we have extensive knowledge about the risk management of both VC funds and the investors of these VC funds, there is a lack of knowledge concerning the risk management of the startups they invest in, as well as their entrepreneurs. It is therefore interesting to understand how entrepreneurs manage risk and uncertainty and what determines their risk appetites, as well as how they view themselves as risk takers. The best way to gain deeper understanding of this, according to Gerring (2006), is via qualitative research, as for example a case study.

1.1 Startup financing

According to a recent report by PitchBook and the National Venture Capital Association, 2017 saw the highest annual amount of capital invested into startups

since the Dotcom era (PitchBook & NVCA, 2018). To understand why entrepreneurs seek VC funding for their startups, it is important to note the characteristics of a startup company. A startup is often a young company without any relevant track-record and without tangible assets. Because of this, they typically involve much more uncertainty concerning future cash flows than mature firms, and there is also a large increase in the systematic risk adjustments for stakeholders evaluating new ventures (Berk, Green & Naik, 2004). Startups are often too risky for banks to be willing to lend money to, and they might not be able to pay the demanded coupon on bonds. In addition, the entrepreneurs are often very talented at what they do, but lack experience of scaling up businesses, finding the right people, or negotiating deals with customers and suppliers. Because of these reasons, entrepreneurs can benefit from seeking financing from investors who have both the capital and the knowledge needed for the business to succeed (Isaksson, 2006). When doing so, it is highly important for all shareholders that risk is managed as efficiently as possible. For this reason, the VC fund will formulate a “risk sharing contract” that creates incentives, as well as formal rules that align the entrepreneur’s risk appetite with that of the VC fund (Reid, Terry & Smith, 1997). This is one of the main tools the VC funds use in order to manage investment-specific risks.

Since the characteristics of a startup compel entrepreneurs to seek venture capital, this often changes how the startup's business is run. This is since VC financing often implies that the VC fund wants to interfere with the managing of the business and that the fund sets specific requirements on financial and operational achievements as requisites for the startup to receive future financing (Gompers, 1995). This might interfere with how an entrepreneur would otherwise wish to manage the business and its risks.

1.2 Entrepreneurial risks

The belief that entrepreneurs are less risk averse than the common man can sometimes seem as a generally accepted notion. The literature on entrepreneurs goes all the way back to the 1930's, when Schumpeter (1934) first argued that an entrepreneur was distinguishable from both business managers and capitalists in both type and conduct. Liles (1974) highlights that entrepreneurs face several risks related to financial well-being, career opportunities, personal relations and physical well-being that wage workers and managers do not face. Due to this, Liles suggests that an entrepreneur is likely to thoroughly evaluate the different risks related to their business idea and whether they are willing to undertake these, as well as how to best do so. Mancuso (1975) further states that established entrepreneurs tend to be moderate or high-risk takers, while Brockhaus (1980) criticizes this statement, arguing that the propensity for risk taking might not have been analyzed at a time when the entrepreneurial decision

was made, and that the entrepreneur might not have understood what risks were being undertaken. Cacciotti and Hayton (2015) also argue that the fear of private financial and social losses is part of what drives entrepreneurs toward success. However, Stewart and Roth (2001) argue that the risk propensity of entrepreneurs is at least on average greater than that of managers. They also argue that the risk appetite is higher for entrepreneurs whose primary goal is to grow their business, than for entrepreneurs who focus on providing a family income. Block and Spiegel (2015) investigate the risk propensity among entrepreneurs and conclude that entrepreneurs engaging in startup-like companies are to be considered as risk lovers. Since VCs typically invest in startups with the option and potential for rapid growth (Davila, Foster & Gupta, 2003; Keuschnigg, 2004; Jain & Kini, 1995; Engel & Keilbach, 2007; Samila & Sorenson, 2011), it would therefore be reasonable to assume that VC backed entrepreneurs have particularly high risk propensities, and that they would value growth options higher than financial stability on a personal level.

1.3 Real options as a strategic tool

Because of their situation, it is important for entrepreneurs to handle the strategic and financial risks they are facing when developing new ventures. Bowman and Hurry (1993) argue that strategic decisions should be managed and evaluated by being viewed through a real option lens, as managers often want to keep their options open rather than taking definite decisions. With a valuation model such as the DCF, the value of the managerial flexibility will

not be included and neither does it allow the managers to delay their decision. Thus, a more dynamic model, such as the real option model, is more fitting when evaluating projects that can be steered in several possible directions, the authors argue. They further argue that the major drawback of the real option analysis (ROA) lie in what is also one of its greatest strengths, which is the high level of detail of the model. Since ROA is dependent on more details and input data points, it also puts a higher requirement on the user in order to properly get access to and include reliable data. In a sense, using the real option model helps to manage and reduce the risk and uncertainty when investing in new projects as the model is dynamic and accounts for managerial flexibility, meaning that managers do not have to take definitive decisions today.

The managerial flexibility concerns things such as when the options should be exercised and whether or not the options should be expanded, contracted, or salvaged. Bowman and Moskowitz (2001) argue that, for example, a DCF does not properly account the value of such flexibility and is thus likely to underestimate the potential of projects and strategies that are reviewed by managers. The authors further argue that ROA is based on the assumption that there is an underlying source of uncertainty, which let the managers adjust the strategy accordingly.

To the best of our knowledge little is known about how entrepreneurs view and evaluate their companies' different growth

options practically, which leads us in to the purpose of our study.

1.4 Purpose of the study

The case company on which this study is based is a software developer with negative cash flows and who currently lacks significant sales. For this reason, the company has initially needed external funding from venture capitalists, which raises the question of for how long the company's current financing will last and how risk is best managed to avoid too large losses. The purpose of this report is therefore to analyze and gain better understanding of how entrepreneurs in the startup scene handle uncertainty in the development of their businesses in order to avoid failure and gain access to external capital.

1.5 Research question

Because of the mentioned purpose, the research question that we wish to answer is:

How do the entrepreneurs of the case company handle risk and uncertainty in the projects they enter and what value does this create for their company?

To answer this question, we will address this in the following three research objectives.

Firstly, although previous researchers are somewhat divided in their beliefs on the reasons behind entrepreneurs' risk taking (Liles, 1974; Mancuso, 1975; Brockhaus, 1980; Cacciotti & Hayton, 2015; Block & Spiegel, 2015), they all seem to agree that entrepreneurs and entrepreneur-lead

ventures take more risk than other businesses and managers. However, most research on entrepreneurs and risk focuses on the risk appetite for different ventures as a whole, leaving the field of entrepreneurs' individual risk propensities and incentives behind. One exception is a study by Stewart and Roth (2001), who make an interesting distinction between entrepreneurs whose primary goal is to grow their businesses and those whose goal is to provide family income, where the authors argue that the former's propensity for risk taking is higher. Block and Spiegel (2015) find evidence for the difference between these groups, and can also conclude that entrepreneurs engaged in startups are less risk averse than other entrepreneurs. And so the first research objective is as follows:

(1) The first objective is to analyze and understand the entrepreneurs' views on risk and uncertainty for their startup, as well as their own perceptions on the risk they themselves are taking.

The roadmap for young companies is filled with uncertainty, at the same time the road to success is usually long and there is a need for deeper understanding of how an entrepreneur goes about decision-making (Liu & Almor, 2016). There is also a call for qualitative and descriptive studies that deal with the processes of sequential decision-making in entrepreneurship (Burns et al., 2016; Packard et al., 2017). Furthermore, earlier literature has mostly focused on uncertainty regarding technical challenges. Thus, there is a need to

examine non-technical uncertainties as well, Nguyen-Duc et al. (2017) argue.

No research that we have come across has been of a qualitative nature and this is where we wish to contribute to the literature by gaining a deeper understanding of the entrepreneurs' personalities and perceptions on risk. Also, the studied company has given us full access to its internal data, as well as to the contract with its main financier. This gives us a unique opportunity to study the company's risk management practices and analyze how they create value in the organization.

The motivation for the second research objective is by the aforementioned research gaps, and it follows:

(2) The second objective is to analyze the frameworks and tools that are used by the entrepreneurs to manage risk and uncertainty, as well as those the entrepreneurs need to adapt to, and to gain a deeper understanding of how these are used.

The motivation for the third research objective is the following. Ragozzino, Reuer and Trigeorgis (2016) argue that it is of interest to apply real options in cases where the valuation is crucial to the strategy execution, in order to understand how ROA can affect the decision-making. The method of analyzing businesses through a real option lens has been tested in research before, but this has mostly been with the help of second-hand data.

Ragozzino and Reuer (2010) argue that to better understand how ROA could be used for companies, it is interesting to use first-hand data. Several scholars also highlight that there is an interest in applying a real option valuation method on private companies, i.e. subjects that lack historical data from which to retrieve volatility in traded stock market prices (Afik & Zwillig, 2018; Doumpos, Niklis, Zopounidis, & Andriosopoulos, 2015). Of these reasons, we find it worthwhile analyzing our case company's risk management activities and their embedded managerial flexibility through a real option lens to better understand what value these create. The third and final research objective therefore is:

(3) The third objective is to understand the current risk and uncertainty management activities from a real option perspective, as well as what value these add, by analyzing the activities using a real option lens.

1.6 Structure of the report

The rest of the report will be structured as follows. We will begin with thoroughly presenting and discussing prior research within the relevant fields. Following, we will discuss and describe our process and methodology of writing the report, after which we present how the entrepreneurs and the company work to manage uncertainty and risk, as well as what value this brings to the business. This will later be discussed along with the literature and lastly, we will conclude the report and present our suggestions for future research.

2. Literature review

In the literature review, we present the relevant literature that has been screened and used to analyze our findings. The literature relates to risk management, venture capital, and real options.

2.1 The difference between risk and uncertainty, and how to handle them

To understand the entrepreneurs' views on risk and uncertainty, we first need to understand that risk and uncertainty are fundamentally different, even though they are often lumped together. Due to that fact, it is important to understand how and why they differ from one another. Risk can be defined as the deviation from some quantifiable expected outcome. Thus, risk is based on what we know (Markowitz, 1952). Uncertainty, on the other hand, is the lack of quantifiable knowledge (Knight, 1921). Hence, with risk the future is unknown, but the expected probability of a certain result can be calculated, whereas with uncertainty even the probability itself is unknown (Miller, 1977).

Marra, Pannell, and Ghadim (2003) argue that when taking small steps in knowledge-gathering, the risk and uncertainty of adopting a new technology decreases, while at the same time the pace of adoption increases. They also show that with higher cost of adopting and higher cost of gaining knowledge about the new technology, one becomes more hesitant to directly adopt something new. This means that when uncertainty increases one becomes more likely to approach the adoption in smaller steps. By approaching the new adoption in a step-by-step manner, a better understanding and more experience

in the area is gathered, which decreases the uncertainty. Thus, by doing so, uncertainty can be transformed into risk (Marra et al., 2003).

Stirling (1998, p 106) puts it: "Treat the risk assessment exercise as an iterative and reflexive social process rather than as a discrete analytical act". This is due to the fact that risk is not static but rather something we learn about in each step of the process when evaluating the risk and uncertainty (Stirling, 1998). To exemplify, risk can be seen as the variability within a sample group and thus used in calculations, whereas uncertainty remains something we do not know. Therefore, since uncertainty can be viewed as lack of knowledge, the uncertainty can be reduced by gaining better understanding and more knowledge (Thompson, 2002). There are no fundamental differences between different types of uncertainty and they all stem from lack of knowledge, hence all uncertainty should be handled in the same way (Winkler, 1996).

Neither uncertainty nor risk can be neglected by management and should actively be managed. Ward and Chapman (2003) argue that to manage uncertainty, clear goals and objectives should be defined in order to track how well a project is going and to be able to evaluate this along the road. It also helps to prioritize the

objectives, for instance whether time, cost, or performance is most important. This will reduce the uncertainty within the project since the managers can compare how they perform in comparison to the predetermined objectives.

Raz, Shenhar, and Dvir (2002) perform an empirical study on 127 projects to answer the question if project risk management has any positive effects. While they find no correlation between using risk management for projects and the success rate of achieving any sort of technical or functional specification, they do find a correlation between the use of risk management in projects and success in meeting deadlines and budgetary objectives. However, when only looking at projects with high uncertainty, they find that it is clear that project risk management has a positive impact on all four of the aforementioned success factors.

2.2 How entrepreneurs are impacted by venture capital contracts

Seeking financing from a VC fund inevitably creates consequences for the entrepreneurs, who have to give up part of their equity stakes and freedom in the business as they now need to consider external shareholders in every major decision. To understand how this affects the entrepreneur's view on, and management of, risk and uncertainty, we first need to know the characteristics of VC funding and VC contracts, and how this impacts the entrepreneur.

One might say that a venture capitalist invests in entrepreneurs and ideas rather

than established businesses. Or as Agmon and Sjögren (2016) put it, VC funds invest in radical ideas that, if successful, become valuable assets in the market portfolio. Since there are typically no tangible assets but rather ideas that might one day become intangible assets, the risk related to investing in startups is increased. Coval and Thakor (2005) argue that the purpose of a VC fund is to act as a financial intermediary between risk averse investors and risky projects, hence the importance of well written investment contracts. These contracts are often fairly standardized and have been examined in research by Zider (1998), as well as Isaksson, Cornelius, Landström, and Junghagen (2004) who find that the VC often has veto rights in the most important strategic decisions, and that there are clauses made to secure the value of the VC's investment. Such clauses may relate to dilution of ownership and protection of the VC from fraudulent behaviour by the entrepreneur. Thus, this can sometimes hinder entrepreneurs from running their startups as wanted. Regarding these contracts, Zider (1998, p 134) describes the typical venture capital deal in the following way:

“In a typical start-up deal, for example, the venture capital fund will invest \$3 million in exchange for a 40% preferred-equity ownership position, although recent valuations have been much higher. The preferred provisions offer downside protection. For instance, the venture capitalists receive a liquidation preference. A liquidation feature simulates debt by giving 100% preference over common shares held by management until the VC's

\$3 million is returned. In other words, should the venture fail, they are given first claim to all the company's assets and technology. In addition, the deal often includes blocking rights or disproportional voting rights over key decisions, including the sale of the company or the timing of an IPO.”

A common requirement that venture capitalists tend to have is that they want to stage capital infusions into the startups (Gompers, 1995). It is further argued that this might be one of the more effective ways the VC can handle monitoring and reduce losses from bad decisions. By having shorter financing rounds, the investors are forced to gather information about the performance of the investment more frequently, and thus there is a higher pressure on the entrepreneur to perform well. Gompers therefore argues that this method of staging capital infusions will decrease information asymmetries. Similarly, the startup typically raises capital in different financing rounds, and the financing of these rounds can either be ex ante or ex post (Kaplan & Strömberg, 2003). In the ex post situation, the startup gets all the capital up front, but future capital infusions will still be contingent on the startup reaching both financial and non-financial targets. On the other hand, in the ex-ante situation the startup will not get the entire amount up front but rather at different stages when it has achieved some predetermined financial or non-financial target, like just mentioned. Hence, the entrepreneurs need to continually show their potential and improvement to the investors. Thus, when entrepreneurs accept

VC financing they decrease both their equity stake as well as their freedom. Furthermore, their actions become limited to what the investors are comfortable with.

2.3 Risk management and its effects

To analyze the frameworks and tools that entrepreneurs use to manage risk and uncertainty, we need to understand the concept of risk management and its effects on businesses. Traditionally, risk management (RM) has been about reducing volatility and thus creating a more predictable future (Stulz, 1996). The focus has historically been on how companies can use derivatives and other financial instruments in order to reduce volatility in cash flows by hedging commodity prices and foreign exchange rates. Stulz proposes a change in perspective where the focus rather should be “the elimination of costly lower-tail outcomes — that is designed to reduce the expected costs of financial trouble while preserving a company’s ability to exploit any comparative advantage in risk-bearing it may have” (Stulz, 1996, p 8). Hence, companies should focus on what they know and minimize the risk in any other activities it might engage in.

The field of risk management has developed beyond just managing financial risk and volatility in cash flows, by for instance hedging, into a much wider definition under the practice of Enterprise Risk Management (ERM) (Brustbauer, 2016). The aim of ERM practices is to give the organization a holistic view of itself. This should help the organization to identify opportunities and reduce costs in

downturns. Firms that are more dependent on externally generated capital can have more to gain by engaging in ERM in order to reduce their risk and thus reduce the cost of capital, Brustbauer (2016) argues. Thus, ERM can be viewed as a tool to avoid costly failures as well as a tool to recognize and identify new opportunities.

Traditional RM has focused on cash flows and commodity price and thus the practices are generally not applicable on startups, since these typically lack both meaningful cash flows and commodity dependency. However, the reasoning is still relevant since startups face tremendous risk due to unstable cash flows and immature business ideas.

Brustbauer (2016) argues that firms' strategic orientations can be categorized as either defenders or prospectors. While the former take on defensive and reactive approaches, the latter are rather offensive and instead of reacting to others, they themselves analyze and innovate in order to please the market. The prospectors try to find new opportunities in a changing environment. What characterizes the prospectors is market expansion, product introduction, and investments in R&D. However, many small firms struggle with implementing ERM due to lack of resources. Brustbauer (2016) shows that prospectors can gain an advantage by engaging in an active ERM approach and increase their competitiveness and also increase the likelihood of finding new opportunities. He also shows that the positive effects of ERM appear to persist in the long run. By their natures,

entrepreneurs and startups would typically be categorized as prospectors.

Bannerman (2008) argues that RM in commercial software projects promises to improve the outcome. This is meant to be done by, for instance, identifying alternative courses of actions through the process, reducing the likelihood of unwanted surprises, helping to create more precise estimates through reduced uncertainty, as well as reduced likelihood of work duplication (Simister, 2004; Ward & Chapman, 2004).

The three most common RM practices in software projects are, according to Bannerman (2008):

- (1) Checklists to revise and assess a project against other projects to assure that all risk factors are appropriately accounted for.
- (2) Analytical frameworks might in other cases be preferred, since screening for many individual risk factors in a checklist can become inefficient.
- (3) Using process models is the most common approach and is a way of specifying stepwise tasks for managing risks. Usually, the most necessary activities to manage risk in software projects are specified as guidelines.

2.4 Tools and frameworks to handle uncertainty within software development

It has been shown that large projects, such as developing a software, can advantageously be broken down into smaller projects so that the larger project

can be dealt with more efficiently. Another advantage is that the team can be more agile and better adapt to the changing environment to create a better suited product (Cervone, 2011). Serrador and Pinto (2015) argue that agile project management can effectively be used to handle uncertainty, and conclude that agile project management has a statistically significant positive impact on project success, as judged by efficiency, stakeholder satisfaction, and perception of overall project performance.

In agile project management, the grander goal is broken down into smaller projects, often referred to as sprints that usually last only a couple of weeks (Inayat, Salim, Marczak, Daneva, & Shamshirband, 2015). By using this method, the development can be more flexible to the customers' changing demands and thus handle uncertainty in a more sequential manner. The grander goal is then revisited after each sprint. By handling it this way, all the details do not have to be in place in the beginning of the project and the overall development is allowed to be more dynamic. In the same time the risk is reduced as the customers' demand is always kept in mind. Inayat et al. (2015) find that this has shown to make companies more productive and require less rework on their projects, thus reducing development costs. By working in sprints, it is also easier to continuously evaluate the projects and whether or not it should continue.

The agile development team is often smaller but this allows them to focus on only one project at a time, Abrahamsson,

Salo, Ronkainen, and Warsta (2002) argue. They find that only having one focus area has shown to increase both the productivity and the quality of the product. This team formation also allows the members to better help and learn from each other.

In short, agile project management is a way of dealing with uncertainty when the road towards the end goal is unclear, as it often is for entrepreneurs.

2.5 Real options as a strategic tool

As Bowman and Hurry (1993) argue, looking at strategy through a real option lens can help managers reduce uncertainty by dividing the projects into multiple stages. Using the real option lens may help organizations adapt to the goals of projects as opportunities change (Bowman & Hurry, 1993). Furthermore, Luehrman (1998) argue that ROA can be very beneficial when evaluating a portfolio of growth opportunities in order to choose what investments to make and what investments to delay. Thus this can be particularly useful for entrepreneurs and their situations which are often characterized by uncertainty and sudden changes.

Using ROA for strategic decisions allows the management to analyze the effect of executing an investment now or to wait, as well as the effect of abandoning current and future investments (Koussis, Martzoukos, & Trigeorgis, 2013). Using the ROA would also allow managements to alter their analyses to the changing competition and arrival of new information.

Newton, Paxson, & Widdicks, (2004) argue that the usefulness of ROA is derived from the fact that it incorporates managerial flexibility, whereas the common discounted cash flow analysis fails to do so. They state that one of the more important aspects included in the ROA is the option to expand, contract, or abandon the project. To include the abandonment value allows the manager to also reflect upon the value that the company still could attain would the manager choose to exit the investment project. Furthermore, they state that to include these values better mimics the risk of the project. Thus, the RM activities can be seen as the representatives of managerial flexibility in the ROA.

2.6 Valuing risk management

It is easy to argue that a newly started business based on an innovative idea is characterized with more strategic flexibility than a mature firm, since the company has not yet established a practice on how the everyday business is conducted. A lot of research has been done regarding how startups and firms with strategic- and financial flexibility should be valued. Even though several different types of valuation methods are used by practitioners (Buckley, Tse, Rijken, & Eijgenhuijsen, 2002; Wright et al., 2004; Köhn, 2018; Miloud, Aspelund, & Cabrol, 2012; Dittmann, Maug, & Kemper, 2004), the general consensus among researchers seems to be that a real option approach is the best way to capture the intrinsic value of such a company (Trigeorgis, 1993; Boer, 2000; Banerjee, 2003). The operational and financial flexibility in a startup can arguably be considered closely linked to the

practices conducted to manage uncertainty and risk in projects. In these situations, the ROA framework can be useful, both to evaluate the projects but also to measure the value of different risk management practices. To better understand and estimate this value, it is therefore reasonable to analyze the risk and uncertainty management activities by viewing them through a real option lens.

2.7 Applying the real options method in practice

There are two basic option pricing models that the investor is likely to choose from. The first is the Black-Scholes (B&S) option pricing model (Black & Scholes, 1973) and the second is the binomial option pricing model. Trigeorgis and Ioulianu (2013) use a binomial real option valuation approach to value a company named EchoStar Communications. In the binomial model, both European and American options can be valued, although more information is needed than in the B&S model. This is since one needs to be able to specify the prices of every branch in the model, as seen in Figure 1. One also need to be able to specify the probabilities for each movement along the binomial tree.

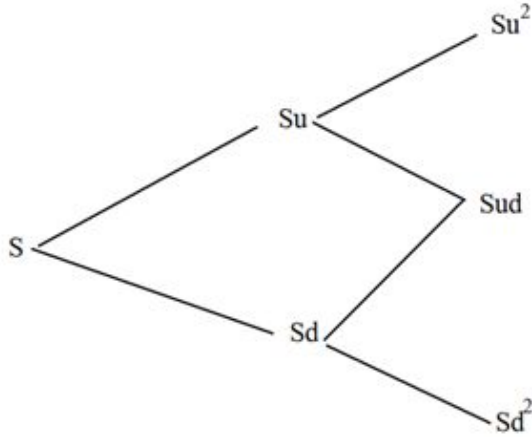


Figure 1. *General formulation for the binomial price path* (Damodaran, 2005).

Trigeorgis and Iouliau (2013) first create a proforma of the case company's discounted free cash flows for the next five years and include the residual value. In order to calculate the WACC they use the adjusted beta. The proforma is used as the base scenario when later applying the real options valuation method. However, some corrections are made to arrive at what is called base DCF. Firstly, the residual growth is removed, and capital expenditure is set equal to depreciation under a sustainable no-growth policy. When creating the binomial option tree, they do so with the options to either expand different product segments but also include the option of exiting, i.e. selling off the company's assets. By including the options, it is argued that the growth options of the firms are more precisely valued. The growth opportunities are discovered via extensive market research as well as its probable costs and potential returns.

The first formula for calculating the up and down movements in the binomial tree model is as follows:

$$u = e^{\sigma\sqrt{\delta t}},$$

$$d = e^{-\sigma\sqrt{\delta t}}, \quad d = \frac{1}{u},$$

Formula 1.

where u represents the up movement and d represents the down movement, σ is the volatility in the underlying asset and δt represents the steps in the binomial tree (Mun, 2002). The second formula for the risk neutral probability is the following:

$$p = \frac{e^{(rf-b)(\delta t)} - d}{u - d},$$

Formula 2.

where p represents the risk neutral probability, e stands for the exponential constant, rf is the risk-free rate, b is the dividend payout, δt represents the steps in the binomial tree, d represents the down movement, and u represents the up movement (Mun, 2002).

Kenyon and Cheliotis (2002) show that the real option method can be used to properly value investments that do not immediately give rise to cash flows but that might rather do so in the future. Schwartz and Moon (2000) underline the importance of properly estimating the parameters. While some of the parameters they used are easily observed via the financial reporting, some of the parameters require more thorough analysis of the situation. To estimate the initial growth in revenue, Schwartz and Moon (2000) used the average of the last two quarters. The growth for the following four quarters was based upon market

researchers, while using the volatility of the stock as a parameter for volatility in the revenue. 1.5% of quarterly revenue growth was used for the long-term rate of growth in revenue and 5% quarterly volatility was used for long-term volatility. The authors run their model through 100,000 Monte Carlo simulations. The original model is later expanded in order to include variable costs and the tax effects from depreciation (Schwartz & Moon, 2001).

3. Methodology

In the following chapter, we begin with describing the characteristics of the case company, before explaining the research methods used, as well as the framework on which the analysis is based.

3.1 Company description

The company that has been analyzed in this paper is a tech startup, founded in 2015 by two entrepreneurs, with about 40 employees and 40,000 active users. During the study, the founders held the positions as CEO and CTO. The company provides a software and has small and medium-sized enterprises in Sweden as their targeted segment group. To make business easier, they use machine-learning and artificial intelligence to improve their business software for smaller firms. While the base service is entirely free there are some add-on services that the users can choose, and the company's main growth opportunity lies in improving these and adding new services to create cash flows to the company. The company had at the time of the study achieved their first round of VC-funding and projected to have high growth in number of employees and active users. During the research, the company's main focus lied on developing the software. However, the company had also started looking at growth opportunities outside the core product as well as put some focus on analyzing the market and its peers.

3.2 Literature screening

The research before this report started with a literature screening that was done to ensure both the relevance and uniqueness of the study, as well as to find guidance on how to approach the problem. The

literature studied was all regarding risk management, venture capital, and real options. It was obvious that, despite some discussions in various directions in the broader sense, there seemed to be something similar of a consensus on how to approach at least some of these questions when narrowing down and specifying the problem. For example, different venture capital firms tend to value companies differently, and even internally, the same venture capital firm often values different portfolio companies using different methods. However, when the question was narrowed down to specifically valuing high-growth, pre-revenue startup firms, characterized by both strategic- and financial flexibility, both researchers and venture capitalists seemed to agree that a real-option approach is the theoretically most suitable method.

Much of the studied literature covered the risk management of VC firms and their approaches to uncertainty management, but there appeared to be a research gap in how the entrepreneurs themselves go about. The research areas that have been screened have not yet been connected to each other, not that we are aware of, and thus having a wide and thorough literature screening was necessary.

3.3 Gathering empirical data

During our research, we have been located in the office of the case company and have been able to observe the day-to-day routines as well as to interact and have prolonged discussions with the employees and founders of the company. To fully understand the processes and the reasoning of the company, we observed the organisation over a prolonged period of time and thus did not need to rely on observations from single events. We were allowed to take part of meetings, presentations regarding past performance and future opportunities, as well as the biweekly sprint evaluations. This let us gain a deeper understanding of how the organisation reasons, as well as gain insight into what the tree of decision looked like. We also held formal interviews with the CEO and CTO separately, for which the prepared questions can be found in appendix 1, as well as more casual, non-prepared discussions with them both, and the head of business development. The fact that the case company granted us access into their intranet also gave us the opportunity to see strategic documents which gave us an insight into the decision-making, as well as their own development of a project selection framework.

In more unstructured ways, such as simply having lunch and coffee breaks with the employees, we gained insight into the unity of the teams, what problems they were facing, and how they planned to overcome these. As we got this insight into the reasoning of the teams, we could better understand how they operated and how

they managed the risk and uncertainty within their projects.

3.4 Research approach

This study was based on knowledge gained from one specific company, instead of from a larger collection of data retrieved from many companies or individuals. There are both benefits and disadvantages related to conducting such a case study. Gerring (2006) argues that gaining knowledge from one individual example can sometimes be more helpful than to retrieve it from a larger number of examples, and that we can often gain a better understanding of the bigger picture by focusing on a smaller part of it.

Since we were located in the office of the case company, we were not solely dependent on what we were told in interviews but also had the opportunity to analyze the company's practices based on practical observations. Being able to observe a company can give access to insights that otherwise would be inaccessible (Stake, 1978; Tellis, 1997; Helper 2000). Methods like these can help us get a better understanding of how and why the studied company acts and decides in the ways it does (Gerring, 2004).

The data used in this study was of such nature that it was unlikely to ever be available in a public data set together with similar data from other companies. Of that reason, the only suitable method to gain understanding about how startups handle risk and uncertainty was via case a study. However, this single case study will not be sufficient for drawing broader conclusions

about how companies act in the researched situations in general. But like Gerring (2006) argued, focusing on a smaller part of a total population can still be helpful in gaining knowledge about the bigger picture.

Due to the private nature of the information in this study, we have agreed to not disclose any confidential information. This includes all details that could reveal what company was being studied, including details such as market, industry, or financial information that might be used. Hence all output numbers that have been presented are not real and should not be interpreted as such. However, they have all been adjusted with the same factor, meaning that their relative sizes still resemble those of the case company's, but are not representative in absolute numbers. While this could be seen as lowering the reliability of the report, the insight was perceived as more valuable than the loss of reliability.

3.5 Primary vs secondary data

An aspect that was highly valuable and contributed tremendously to the quality of the study was the access we had to primary data, both quantitative and qualitative. The case company gave us full access to all internal customer data, growth estimations, strategic evaluations and financial contracts. The transparency that they were generous enough to provide us with was unique and unlike the data used in any other study that we came across throughout the time of writing. In practice, this was primarily done by giving us personal logins with full access to the company's intranet,

where most of the just mentioned information was provided. The main exception was the terms in the contract with the venture capital firm, which was communicated orally, since it was not part of the information on the intranet. One of the most prominent advantages related to using primary data, according to Hox and Boeije (2005) is that, unlike secondary data, it is not meant to be used for any other purpose than what it was used for in our study.

3.6 Viewing the case through a real option lens

To understand the risk and uncertainty management activities from a real option perspective, as well as what value these add, the analytical framework on which the analysis was made is therefore based on what Bowman and Hurry (1993) describe as a real option lens. A real option lens can be explained as a framework where strategy is seen as a process of organizational resource-investment choices, or in other terms, as options (Bowman & Hurry, 1993, 1987; Hurry, 1994; Hurry, Miller, & Bowman, 1992; Kester, 1984; Kogut, 1991; Myers, 1977, 1984; Sharp, 1991). In our case we focused on the processes within the company, which in practice meant that all methods used to gather empirical data, including formal interviews, practical observations, as well as financial valuations, were made from a real option perspective. For instance, the questions asked in the formal interviews (stated in Appendix 1) that were conducted during the qualitative data collection process, were all formed with the purpose of gaining knowledge about how risk and uncertainty

was managed in new projects and in what ways this was affected by the contract with, and relation to, the venture capital fund. Formal interviews were held with the CTO and CEO, as well as the Head of Business Development. In real option terms, the questions asked to the CTO related to what options had been embedded in previous projects and how to estimate the values of these, how previous decisions had been made on what options to exercise and how the exercises were made in practice. The questions asked to the CEO related to how the ownership was currently structured and how the contract was formed, as well as how this was believed to affect the entrepreneurs' management of the company. Furthermore, the Head of Business Development was asked questions related to how the estimations of future cash flows from the potential add-on services were made, which was information of high relevance for the reliability of our option valuations.

Our focus was on observing how the entrepreneurs made decisions and how the processes of management and development appeared in practice. This was done by attending the biweekly evaluation meetings where every project's progress was presented and evaluated by the company's different developing teams.

The collected qualitative data regarding risk management practices was then compared to the academic literature, which made us able to draw relevant conclusions related to the practices of the case company, as well as if, and how, these practices connect to real option theory.

To draw conclusions on what value the risk management activities added, real option valuations were conducted where the future projects were valued with, and without the continual options to expand, contract, or abandon. The motivation for using this method of valuing the risk management lied in the case company's extensive relying on sprint project management, where projects are evaluated and potentially reshaped every second week.

3.7 Valuation of the risk management practice

Seeing as the company works in two-week sprints ending with a time for reflection and giving a chance to reevaluate the situation, the same time period was used as each step in the binomial tree. We calculated the projects over a two-year period and thus we had 26 steps per year and 52 in total. At the time of the study, there were 6 projects in the pipeline whose option premiums were included in the valuation. Included was also a static base case DCF for the part of the firm that was not developing projects but rather used the software to create revenue. The static base case DCF does not include, and is not included in any of the options, as this represents a division of the company that does not take part in any new development.

Since the company at the time only operated in Sweden, the risk-free rate was retrieved from the Swedish central bank, and the tax rate was based on the local corporate tax rate. The long-term growth rate was based on the Swedish long term real GDP growth. Furthermore, the market

premium was based upon screened research of the Swedish market.

3.7.1 Static NPV for the base case

The static NPV, hereafter sNPV, was calculated on the only part of the company that was making revenue. This was since this part of the company was not involved in the development of new projects and would likely be the only part left if the company would not develop new projects, thus the static part. It is important to note that this part of the valuation only contains cash flow streams that the company themselves create while using the software to sell services. Thus no cash flow streams that could be achieved in indirect ways, such as royalties, were included here as these rather should be contributed to the value of the projects they stem from.

Since this part of the company was relatively young there was not much historical data for the specific entity to rely on, so the numbers were benchmarked against market averages and different market researches. Appendix 2 and 3 summarize the reviewed financials and market data that were used when calculating the sNPV in the DCF, as well as the base case DCF itself. For the following years, the numbers were calculated to grow in accordance with the observable trend. However, since these were very optimistic for a long-term stable period, they were compressed to better reflect the industry averages.

The DCF was reviewed over a 10-year period, ending with the terminal value for the base case. Since the company mainly

focused on developing projects, the sNPV for the base case was rather small in perspective.

3.7.2 Assumptions for the ROA

The sNPV for each option, which the option valuation relies on, was based on estimates from the company. Furthermore, since there were no previous internal projects similar to the ones valued, there were no obvious sources to retrieve the volatility from. Of that reason, the volatility used was retrieved from the company's monthly cash flows on an aggregate level. In practice, this was done by measuring the standard deviation of the logarithmic returns on the company's monthly free cash flows, which gave us a volatility of 40.55 percent, as can be seen in Appendix 6.

The growth estimates for the different add-on services were conducted by the case company themselves, and it was thus retrieved from their own market experience and customer knowledge. Due to this, and to the difficulties related to do estimations based on peer companies- and projects, when the available data is limited, made us regard these numbers as the most trustworthy and relevant to use. In the situations where the case company had conducted internal estimations, we therefore decided to use these without adjustments based on our personal opinions in the models. A specification of where the different estimates are retrieved from can be seen in Table 1.

The expected annual revenues from each project were based on how much the customers spent on similar services today

and how many of these customers the company believed were likely to convert to their service when released. Add-on service 1 and 2 were believed to be fully implemented in 2019 and add-on service 3-6 were believed to be implemented during 2020. Since no service was expected to be running for the full year it was implemented, we estimated a one-year lag in revenues. This means that for service 1 and 2, which are implemented in 2019, we estimated revenues from 2020 and forward.

Description	Abbreviation	Retrieved from
Financial data on the case company		The company
Estimated growth (base DCF)	g	Company's own estimates
Projects as options	Add-on service n	Company's management
Projects market potential		Company's own estimates
Projects expected growth	g	Company's own estimates
Projects cash flows	FCFF	Company's own estimates
Risk free rate	rf	Sweden Central Bank
Periods in options	δt	Company's management
Volatility	σ	Company's cash flow volatility
Beta	β	Estimated using peers
Expansion factor		Company's own estimates
Expansion Cost		Company's own estimates
Contraction factor		Company's own estimates
Contraction gain		Company's own estimates
Salvage value		Company's own estimates
Long term bond rate		Market data

Table 1. Table of input data for valuation

The costs for developing and maintaining each service were based on how many full-time equivalent developers were needed and then multiplied by the historical average cost per employee. These costs were also used to retrieve the exercise prices for each option. The exercise prices were estimated as the total cost for all employees during the project at hand. Overhead-costs and employee costs that were not project-specific were considered in the sNPV.

The expansion factors used in the binomial tree were calculated by dividing the amount of users in a good scenario with the most likely number of users expected to convert to the company's respective service. When calculating the contraction factor, the company's full capacity was divided with the number of projects in order to retrieve the capacity per project.

The salvage value was estimated to be zero for all add-on services. The motivation for this was that the only asset created in each project had historically been intangible in the form of computer code, which had never been either sold or used again.

3.7.3 Pricing the projects as options

Our valuation model was done partly based on the model used in the 2013 article *Valuing a high-tech growth company: The case of EchoStar Communications Corporation* by Trigeorgis and Ioulianou, where EchoStar Communications was valued using real options. We have also used Mun (2002) as a basis for building the model. This was done by replicating the

models found in the appendixes of the articles, and then adjusting the numbers to our case company as well as some of the input data points. The binomial tree of the underlying asset used the up and down movements to calculate each step. The total number of steps were 52 with 26 per year, representing the sprints that the company worked in. In each step of the binomial tree, the maximum value of the option to expand, contract, salvage or to hold the option until next period was chosen, thus managerial flexibility was valued. This valuation should also reflect the value of the risk and uncertainty management activities which should likely increase the value of the company. The basis for the calculations can be viewed in Appendix 4 and 5.

3.7.4 Robustness check

In order to check our valuation for robustness, we compared it with Monte Carlo (MC) simulations based on the models presented by Moon and Schwartz (2000, 2001) but adjusted to fit our case. When calculating the MC simulations, we included the underlying sNPV of each option as well as their strike prices. Growth was included and based on the estimations from the case company. The volatility used in the MC simulations was the same as in the real option analysis, and the growth options were included together with the potential contraction savings. The output was then indexed based on the value from the ROA binomial tree valuation.

We also compared this to the value retrieved from calculations based on Black and Scholes' (1973) valuation method. This

was based on the same assumptions and estimates in order to establish whether our initial valuation was valid.

4. Empirical evidence

In the Empirical evidence chapter we describe the entrepreneurs' views on risk and how they handle it, their relations with investors, how projects and teams are being chosen and managed. Lastly, we also present our valuation of the company's risk management practice.

4.1 The entrepreneurs' views on risk

None of the two founders viewed themselves as neither risk averse nor risk lovers. They did not think that they were heavily invested in the firm in financial terms, more than the opportunity costs related to their current below-market salaries, since most of the financial capital had been provided by the VC fund. None of them believed that they would have a hard time finding other occupations if something would happen to the company. Neither did anyone of them, when asked directly, express that they took on any substantial risk when they initially started their venture.

Their overall view on risk was that they were risk aware but were still willing to take calculated risks that were likely to benefit the company. The CTO argued that he was unwilling to take risks that were likely to negatively affect anyone else, in particular the users, and that he and his team were especially aware of risks that might cause damages that could not be repaired. An argument to this was that events that might negatively affect customers could potentially have a fatal impact to the company. Of that reason, changes to the company's products and services were reviewed more extensively whenever they were believed to have a larger impact on the user experience. Smaller changes could however be released

quickly without extensive alpha- or beta testing.

The CTO was also the company's safety- and data protection representative, meaning that he could be legally accounted for wrongful handling of customers' data.

4.2 The investors' involvement

The CEO revealed that the ownership was divided so that the entrepreneurs owned 60% of the company, while the venture capital firm owned 15%. The last 25% was divided among different investors with smaller stakes in the business.

All external owners held preferred stocks with the opportunity to convert to common stocks. The venture capital firm had the sole right to all future profits and/or capital gained in public offerings up to a certain amount where their initial investment would be regained. This agreement was mainly meant to be a financial guarantee for the VC, but also to give incentives to the entrepreneurs to strive for a valuation higher than that amount. Furthermore, the VC-contract required the two founders to stay in the startup for a minimum of three years after the signing date of the contract. If any of the founders were to resign, he would lose the right to his shares in the company. Also, the owners had below-market-salaries and did not enjoy any perks paid by the company. This was

believed to completely reduce agency costs between external shareholders and the entrepreneurs.

The CEO explained that a demand from the entrepreneurs was to receive all capital at once, and not have it staged throughout projects. The reasoning behind this was that the entrepreneurs did not want to risk sub optimizing certain projects to meet required objectives in others to receive financing. From the entrepreneurs' viewpoint, it was better to gain trust from the VC in other ways so that they too did not feel a need for staging the capital infusion. This was a demand that the VC was prepared to meet from the beginning. An argument from the VC was that providing all capital at once lowers their total transaction costs, since the need for operational monitoring decreases.

The VC was said to be prepared to provide more capital in the future if necessary. A requirement from the VC had been that they should always be offered a minimum of 15 percent of the shares in any new share issuance so that their ownership would not be diluted. A potential exception where the VC would not be prepared to take 15 percent in a new issuance was if the valuation of the company increases to a degree that they simply could not afford to provide more capital.

At the time, the board of directors consisted of four members who met every second month. One of the members was a representative from the VC firm, another was the CEO, and the last two were minor external shareholders. The entrepreneurs

argued that they had a large degree of operational freedom and could make most decisions without the involvement of the board or the VC. For example, most potential investments and projects could be undertaken if they fitted the original budget, we were told. However, the startup or its entrepreneurs could not decide to acquire or sell intellectual properties or businesses without an approval from the board. The VC firm did usually not have any opinions on the operational projects, more than that they wanted to make sure that all decisions and ideas were well thought through. It was not uncommon that a VC-representative wanted detailed information about future projects just to make sure that the ideas were not rushed.

4.3 The development of a project selection framework

From our interviews with the entrepreneurs, as well as from strategic documents on the intranet, we learnt that since the company had negative cash flows due to their capital intensive business model, it was important to make sure that no time and money was wasted on unsuccessful projects. The company was simultaneously looking at multiple projects in order to quickly improve and develop their services, but the company of course had limited capital and a limited workforce. Thus, the company could not engage in all possible projects at hand. Hence the company had to choose the most value-adding projects and reject those projects that were not adding enough value to the company or the user.

Choosing projects was in the beginning mostly based on gut feeling according to

the CTO. However, in the beginning it was more about creating a software that actually worked and at that point in time it was easier to see and understand what needed to be done. As the company had grown and matured, better techniques than pure gut feeling had evolved, but the CTO still felt that there was quite much room for improvement in this matter.

From our observations at the biweekly sprint meetings, we noted that the company was investigating what kinds of questions the support team got from the users, what the users wrote about the company on social media, and what they answered in surveys. Since the company was still young and their software still needed improvement, they focused solely on those improvements that could add the most possible value and utility for the users and thus it became relevant to look at what the users were actually requesting.

As mentioned before, more knowledge about how to choose new projects and software improvements had been gained as the company evolved, but there were still improvements to be made in this sense, according to the CTO. At the time, there were no predetermined number of users to be surveyed, nor were there any agreed upon process of researching what the users wanted before making executive decisions. We were told that this had sometimes caused problems as people had been deterministic and surveyed users until they received the answers they were looking for, which had made the company pursue projects that later turned out to not add as much utility as initially believed. This was

however being investigated and more structured ways of going about it was being developed.

As the company had grown and gained more users, the financial aspect had become more relevant for the company, the CEO explained. Research about profitability and potential market size was being reviewed and brought to attention as well. However, avoiding projects and improvements that could be financially hurtful but long-term value adding was still more important than pursuing projects that could potentially have a large financial upside in the short run. While the company had learnt how to better select projects, it had also become more relevant for them to learn how to deselect and avoid projects that do not create user utility or that might be too financially harmful for the company.

At the sprint meetings, we observed that a project that was believed not to bring any user value or utility would never be pursued. A project that could, in any way, effect the users majorly in any negative way would also never be pursued. Thus, it was clear that creating a software that was useful and valuable for the users was the most important objective. The CTO further explained that whether a project could put the company in any legal risk or if the user data would in any way be jeopardized were also issues that were important for the company to avoid. Then, there was also the question of how technically complicated a project might be. At the sprint meetings it eventually became evident that if a project was too technically complicated, it might also be too expensive to develop in relation

to the possible user value or revenue streams it might add.

When selecting and deselecting projects, the company had gone from basing their decisions mostly on pure gut feeling towards taking more informed decisions where user value and possible profitability was the cornerstone of whether they take on projects or not.

4.4 Project management

While working in the office of the case company, we found that the workforce was divided into smaller teams that only specifically focused on one single project each at a time. This was done in order to let the team members fully understand and focus on the task and problem at hand. This also let the team members avoid being troubled by, or have to worry about, problems in other projects that were taking place.

The teams in each project were a mix of people with different backgrounds, handpicked for that specific project. The CTO explained that this was thought to bring the appropriate and necessary skills and knowledge to each project. By having a mixed team, each team member was believed to be able to see the problem from different perspectives and thus a hivemind was believed to be avoided. However, since the team members work so close together, their personalities must be a good fit. That the personalities are a good fit was viewed as more important than having a perfect fit of technical skills and capabilities. The CTO mentioned that they would never place two employees that do not go along

together in the same team, regardless of how good their technical skills fit. Hence, it was important that the team members enjoyed working together in order for the teams to be able to work independently. Up until recently, the compilation of the teams had come very naturally and self-propelled since the company had relatively few employees, meaning that the management had not had to focus too much on the placement of team members. We were told that this might however come to change as the company grows and more developers join the company.

We found that the teams worked independently with their projects, without the direct involvement of the management in their day-to-day activities. However, this was done in two-week sprints. Within each sprint, the teams themselves defined what the goals and next steps were, and after each sprint the teams presented to the rest of the company their achievements and reflected on why the achieved results were generated. By breaking down the projects into smaller checkpoints, the entrepreneurs believed that the uncertainty could be better managed, which was also believed to make the organization more flexible and better at recognizing new opportunities along the road. Not only did this allow to better recognize new possibilities, but it was also believed that by dividing the projects into sprints it would be easier to shut down projects that no longer had a positive outlook, instead of reflecting on the project first when it was finished in its entirety. Thus, this way of structuring the projects was viewed as a way of managing both the risk and uncertainty within each project.

While the CTO still had quite good general knowledge about how the projects were going and what was happening, the detailed knowledge was lacking. However, the intention was not to have detailed knowledge but to rather work as a bridge between the development of the software and the larger overall strategic intent of the company. While the CEO explained that he had little or no direct knowledge of the development projects, the focus was rather on business development and strategic goals. Together the entrepreneurs could however steer the projects in line with the strategic intents of the company.

The idea of letting the teams work independently within each sprint was to let them gain better knowledge and understanding of the problem at hand, both entrepreneurs argued. It was also thought to give them a better perception of the usefulness of the project and how to develop it further, instead of setting and determining the final goal right from the start. There have been no larger changes to any of the projects started but there have been nudges in desirable directions. According to the CTO, it was also clear that the teams gain more knowledge within each project by working in sprints. Therefore, this was believed to help further developing and improving projects and thus creating more user value. So, while the larger scope of the projects had remained much the same, the details had been crystalized along the way as knowledge had been improved.

While the larger scope had not changed within projects, the entrepreneurs described how the options to wait and to terminate projects had been used. Some projects had turned out to become either too technically complicated to continue or shown to have less user value than previously believed and had thus been paused. As the CTO described, to pause a project was quite easy for them as they are a software company and do not need to erase the project in any sense. The code that the developers write can simply be saved and reviewed later if conditions were to change. This had happened but there was not yet any structured way of how to archive and review these projects. As the company did not have too many projects archived or paused, it was rather simple to remember what projects were in the archive. However, there was a will to better structure this in order to better utilize the archived projects.

There were also cases where projects had been terminated completely, but the code had still not been deleted since it could be useful in later endeavors, we were told. Therefore, the use of sprints and the sequential evaluation of projects seem to work. However, the entrepreneurs mentioned that they wanted to become better at detecting bad projects and shutting them down in order to avoid spending unnecessary time and capital on condemned projects. An example of such a bad project is an add-on service that was integrated from another company where the users needed to contact the other company's support when something did not work properly. This was viewed by the case

company as something that affected the users negatively and decreased user value, which was why the add-on service was discounted from the service portfolio. At the time of the shutdown it had not been released to every user and when seeing how poorly it worked with just a small fraction of the entire user base, it was obvious that it would not work any better with more users. While this project was terminated before it was fully developed and implemented, both entrepreneurs were unanimous in the view that this project should have been shut down much earlier. However, they were also in agreement that the sprints helped them to at least shut it down before it was fully finished and thus saving them some capital and time, but also saving them from releasing a service that would work poorly and thus reflect badly on the company. Thus, while the project still was led to go on for longer than desired, the way of managing the project at least helped the case company avoid integrating the poorly working add-on service with the entire user base.

While the sprints helped the entrepreneurs to reflect and reevaluate the projects so that they could decide if projects should continue, be paused, or to be terminated, they were in agreement that they needed to be better at detecting bad projects earlier.

The company had not worked like this since the start. In the beginning when there was just a couple of developers, a clear structure of how to handle projects was not needed. It was not until the company had 4-5 developers that it started working with sprints. To work in sprints was quite natural

since the CTO previously had been working within IT and software development where this was a very common practice, he argued. How the projects are managed had later been further developed as the company had learnt by doing. This is however in line with the objective of working agile, as the CTO puts it: “the objective of agile management is to create a learning organization”.

4.5 Tools for testing new ideas

Along the development and implementation of new services, the presentations in the spring meetings revealed that the services were tested in different stages in order to reduce the risk of releasing any service of unsatisfactory quality. With smaller updates to the system this was done by releasing new updates, or different versions of the update, to different users. Data on the customers’ reactions and of their usage was then gathered and analyzed. By doing so, the company could gain better understanding of whether the users appreciated the new update or not, and also what they favored and why. Sometimes this had also been complimented by phone- and email surveys to gain deeper understanding of what was good and why.

When there were releases with major changes to the software, or when a new service was added, we found that the process was more thorough, since it would make a larger impact to the users. In these cases some users were picked to be the first testers of the service, called “alpha testers”, and more were later picked to be “beta testers” before releasing it to the entire user base. When engaging with alpha testers, a

very rough draft of the new service was presented in order to get an idea of whether the users liked the direction of the project or not. In this stage, only a small sample group was used. Later when the first feedback had been received and the project had been refined further, the use of beta testers began. The group of beta testers was larger, and the release tested was usually more refined and closer to the aim of the final version. However, in order to minimize the risk of releasing an update that was too incomplete, this version was not released to the entire user base in this stage. Again, the feedback from this stage was acknowledged and used in order to reflect upon the current state and how to further improve it. These actions were argued to be in place to reduce the risk that an unwanted and unsuccessful update would be released.

By engaging with the users of the service and asking for their feedback all along the way, the company could be more in touch with what their users wanted and avoiding to waste time on something that later would be neglected. This method of constantly listening to the users was meant to help changing or exiting unsuccessful and unwanted projects earlier than they otherwise would have, according to the entrepreneurs. By also gathering data and analyzing it at each stage, the company avoided making decisions purely on gut feeling and could make more well-informed decisions.

4.6 Valuation of the risk management activities

In the biweekly meetings, we found that when the company reviewed new add-on services, it engaged with its users to find out their demands and preferences before starting the development process, and thus reduced the risk of developing unwanted services. When the company then tried to establish estimates regarding potential usage and revenue brought by the services, the Head of Business development told us that he used both internally gathered data on user behavior as well as market research performed by external sources. He further argued that they were not aggressive but rather modest in their estimations. The reasoning for this was to avoid disappointing investors and lose their confidence.

4.6.1 The value with and without risk and uncertainty management

Option	Value of Option Without RM	Value of Option With RM
Equity Value of the firm	100	416,87
Add-on Service 6	40,45	257,4
Add-on Service 5	29,96	71,46
Add-on Service 4	27,27	66,11
Add-on Service 3	0,33	15,59
Add-on Service 2	Negative	2,95
Base DCF	1,99	1,99
Add-on Service 1	Negative	1,38

Table 2. An indexed value of RM in the options

No obvious synergies have been discovered between the different options, and none of

the options was dependent on any other. This simplified the aggregated valuation as all option premiums could be added together. To get an estimate of the total firm value including the value of risk management, the option premiums were added to the initial sNPV less all capital investments until today. The distribution of each option's contribution to the total value can be found in Table 2, as well as how the values changed when including or excluding risk management in the calculations.

As mentioned in the literature review, the option to expand, contract, and salvage a project can be viewed as the embedded managerial flexibility, and have thus been used to reflect the firm's RM activities in the valuation. Because of this, established two valuation models of which one included the RM activities and the other excluded them. When the options to expand, contract, and salvage were not

included, two of the options were found to have negative values and were therefore not included in the equity value. This was since options out of the money, by obvious reasons, would not be exercised. This showed that a more static valuation model, again by obvious reasons, could not fully capture the true value of a company's growth options. In table 2 we show the value of the options, in descending order based on the value of the options with RM included, as well as the firm, with and without RM, and compare them to each other. The values have been indexed based on the valuation of the case company without RM. Figure 2 illustrates the relative value of RM for each option as well as the entire firm. Add-on Service 1 and 2 were not included as these had negative values. We can clearly see that the premiums for the RM activities are noticeable and valuable to the entrepreneurs.

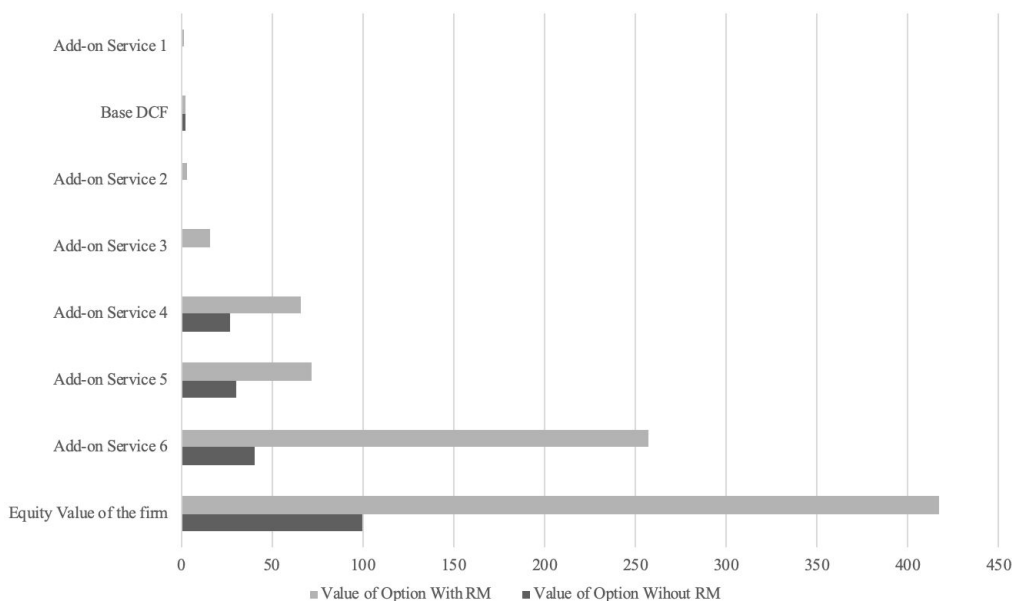


Figure 2. Relative valuation of RM

4.6.2 Sensitivity analysis

To test which inputs were the most crucial to correctly estimate the value of the options and to find out where the model was most sensitive, we ran a test where we increased and decreased the different inputs with 20 percent to their original values in order to test how this affected the value of the options. The results are illustrated in Figure 3 below, which shows that changes in the expansion factors have the largest effects on the value of the options, while changes in expansion costs affect the value of the options least.

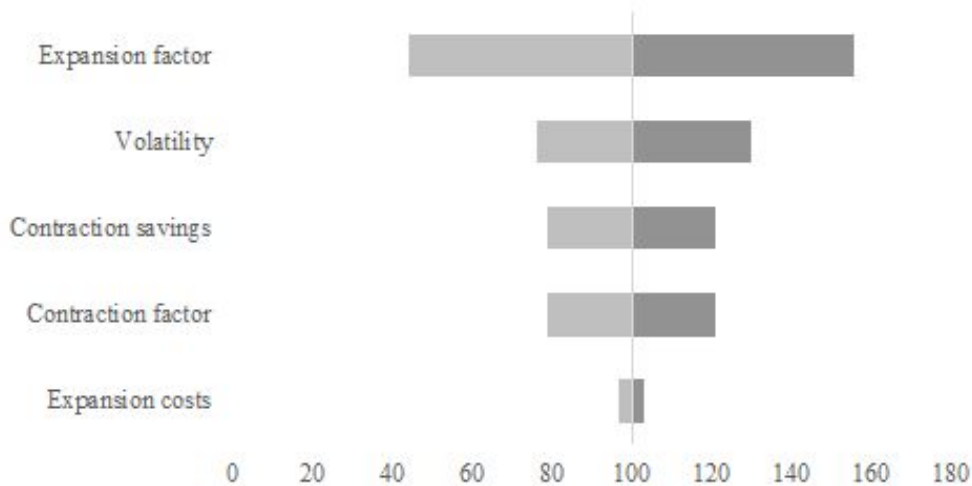


Figure 3. Tornado plotted sensitivity analysis

4.6.2.1 Volatility

When increasing the volatility with 20 percent (note: percent, not percentage), the value of the options increased with 30 percent.

When decreasing the volatility with 20 percent, the value of the options decreased with 24 percent.

4.6.2.2 Expansion factor

When increasing the expansion factor with 20 percent the value increased with 56 percent, contingent on the model choosing to expand. Similarly, when decreasing the expansion factor with 20 percent, the value decreased with 56 percent.

For the options where the model did not choose to expand, the expansion factor difference did not affect the value of the option.

4.6.2.3 Contraction factor

If the model chose to contract, increasing the contraction factor with 20 percent increased the value of the option with 21 percent. A decrease of 20 percent in the contraction factor will lead to a decrease in the value of the option of 21 percent.

Increasing or decreasing the contraction factor did not affect the option value if the model did not choose to contract.

4.6.2.4 Expansion costs

When increasing/decreasing the expansion costs with 20 percent, the value of the option decreased/increased with 3 percent if the model chose to expand. If the model did not choose to expand, the value of the options did not change.

4.6.2.5 Contraction savings

When increasing/decreasing the contraction savings with 20 percent, the value of the option increased/decreased with 21 percent if the model chose to contract. If the model did not choose to contract, the value of the options did not change.

4.6.3 Robustness check

Binomial Tree	100,00
Monte Carlo	114,34
Black & Scholes	91,64

Table 3. Indexed valuation, Binomial Tree valuation used as basis for index

In the Monte Carlo model, we ran 10,000 simulations over 52 periods reflecting the 2-year period with the biweekly options to act used in the binomial trees. The MC model used was based on the model presented by Moon and Schwartz (2000, 2001). Appendix 7 shows that the value of the company is much driven by the estimated growth for the options. As we can see in appendix 8 the mean value was somewhat higher, but the median value was lower than what we got from the binomial trees. Thus, this would imply that the value we got from the binomial trees were reliable.

We also calculated the option price with the B&S method and used the same assumptions. The sum value of the options with the value of the base case DCF included is 91.64 percent of the value retrieved from the binomial trees. This value further implies that our values from the binomial trees were reliable. As can be seen in Table 3, the three valuations were not precisely the same but due to the different characteristics of the valuation methods, it is understandable that they are somewhat different from one another. One major explanation for the difference in value could be that we only calculated based on to years, as the valuations should conjoin over a longer time period. Another reason why valuations differ is due to the fact that the treat the options to expand and contract somewhat different.

5. Discussion

In the following chapter, we discuss the findings in regard to our three research objectives (ROs). For the reader's convenience, every research objective is repeated prior to its related discussion.

5.1 RO1: The entrepreneurs' views on risk

The first objective is to analyze and understand the entrepreneurs' views on risk and uncertainty for their startup, as well as their own perceptions on the risk they themselves are taking.

In contrast with Liles (1974) as well as Cacciotti and Hayton (2015), who argued that entrepreneurs face several risks related to financial well-being, the founders of our case company argued that they had not taken large risks on a personal level. Instead, they both argued that they had not invested considerably in financial terms. The VC provided the major amount of capital needed and was happy to do so, since they knew that the entrepreneurs were not affluent enough. The VC had instead found other ways to design the contract between the parties to align their respective incentives efficiently. One of few prominent ways in which the entrepreneurs had sacrificed financial well-being was their current below-market salaries. It should however be noted that this was partly self-selected by the entrepreneurs, who argued that the capital raised could be better used within the company in order for the business to thrive. In other words, they had agreed to receive lower salaries in the short-term since their focus was to increase the value of the company in a longer term.

This can be seen as an example of how the contract between the VC and the founders has achieved the goal of aligning the incentives between the parties. However, it could also potentially be seen as situation where the entrepreneurs are not fully aware of the proportion of the risks being taken, similar to Brockhaus' (1980) argument. This is since the probability that the company will eventually succeed and be valued high enough for this financial sacrifice to pay out is unknown. Although, Brockhaus' view might still not be perfectly suited for this situation, since the financial amount being sacrificed every month in terms of below-market salaries is in fact known. The entrepreneurs therefore have a fair knowledge about what amount is being risked, even though the probabilities of success remain unknown.

Liles (1974) also argued that entrepreneurs on general risk other potential career opportunities. Cacciotti and Hayton (2015) further argued that entrepreneurs also face several social risks. Neither of the entrepreneurs in our case company agreed that this applied to them. Contrariwise, starting a new venture like our case company, whose service's user-base is growing rapidly, and whose service is well-appreciated among its users, is likely to be a benefit among potential employers. Although, this argument primarily holds in the short-term, since everyday working at

one company is a day where you do not work for another potential employer. This is however not solely applicable for entrepreneurs, but instead applies to employees in all fields of business. However, it is worth mentioning that this risk is likely to have been more prominent in the early days of the startup, before it had a functioning service and an active user-base. Yet, the entrepreneurs only mentioned the opportunity cost of not choosing a better paying employment as their most prominent sacrifice. They therefore argued not to perceive any substantial risk on a personal level, and that this was true even in the beginning of the venture. We argue that today, the successes of the case company have reached a level where the entrepreneurs are likely to have proven themselves competent enough to become desirable recruits for other companies, and that this confirms the entrepreneurs' view on their low level of personal risk-taking. If the venture would instead have failed early on, the situation would likely have been different, and the entrepreneurs might not have been as desirable for other firms as they are today.

Regarding personal relations and physical well-being, which are also factors that both Liles (1974) and Cacciotti and Hayton (2015) highlighted as risks that entrepreneurs tend to face, we find the relation between the entrepreneurs and the VC interesting to discuss. The VC lets the company handle its operations independently without too much involvement. The entrepreneurs themselves view this as a strength since it means that they do not have to worry about sub

optimizing projects to meet required targets in other projects to gain future funding. Because of this, the entrepreneurs and the employees of the company do not have to worry about gaining needed capital in the short-term, which is likely to reduce the potential stress and negative physical well-being that entrepreneurs otherwise risk facing. Because of this, the entrepreneurs can instead focus on continuing growing the business and improving its service and do not have to focus on operational cash flows.

In conclusion, most of the personal risks that Liles (1974) and Cacciotti and Hayton (2015) pinpointed, do not seem to apply to the founders of our case company. One reason for this might be that the company is VC-backed and that the VC reduces the financial risks and thus lets the entrepreneurs put their focus on operation rather than finances.

5.2 RO2: How the case company is being managed

The second objective is to analyze the frameworks and tools that are used by the entrepreneurs to manage risk and uncertainty, as well as those the entrepreneurs need to adapt to, and to gain a deeper understanding of how these are used.

As we know, risk is the deviation from an expected result whereas uncertainty is the unknown (Markowitz, 1952). In our observations and discussions, the entrepreneurs have repeatedly and in many different areas explained how they and their teams learn by doing and thus changes and

refines the way the business is being operated. Thus, by gaining more knowledge about their own business and development they have been able to develop better processes on how to run projects. In this sense our case company has been able to turn uncertainty into risk much like Marra et al. (2003) argued that companies should do.

While our case company is still young, it is both growing and maturing, and while entrepreneurs themselves might not think in terms of RM it is clear that they are striving towards the three most common practices mentioned by Bannerman (2008). In our talks it has been described that clearer guidelines are needed and more structured processes as well as predetermined ways of analyzing the projects.

While no one at the case company was talking about RM and no type of active decision had been taken in commitment to RM, there were many aspects of how the company was being operated that were similar to those suggest in the literature of RM. For instance, the staging of the projects came from experience of working within IT and not from the purpose of mitigating risk per se. At times the CTO even used the term “option to wait” when discussing project management, and thus showed evidence of mimicking the real options theory in practice without realizing it himself. While the entrepreneurs themselves did not talk about or realize that they viewed their development projects as real options, their way of handling the projects was very similar to what Bowman

and Hurry (1993) argued that managers should do.

It is interesting that that both entrepreneurs expressed that they and the entire organization, were learning as they were doing, much like the literature described. As the CTO put it, they are creating a learning organization. While the entrepreneurs were trying to let go and not get involved in detail in the development projects, they had not been able to fully do so yet, which could hint that they are risk averse and not completely let go of the control.

It is quite clear, when looking at everything from how the company chooses which projects to take on, to when they released new updates and improvements, that it was very important for them to avoid both financial downside and any negative effects towards the user base. This goes in line with what Stulz (1996) argued that companies should focus on, i.e. reducing costly lower-tail outcomes. Thus, while the entrepreneurs said that they were not taking on any significant risk, they certainly acted like they were. The CEO told us they did not want to take any bets but rather calculated risks. When reviewing their methods of running the company, this quite clearly seems to be the case in reality as well. So, while they might not themselves perceive that they take any risk this might be because they actively work to mitigate any unnecessary risk.

5.3 RO3: The value of risk management

(3) The third objective is to understand the current risk and uncertainty management activities from a real option perspective, as well as what value these add, by analyzing the activities using a real option lens.

As presented under the empirical evidence chapter, the difference between including the managerial flexibility and not including it was substantial. However, the case company was in a very unstable and risky phase where they were also dependent on external capital to survive. Thus, the risk was severely increased, and RM should be of higher importance, and therefore of more value. As argued by many authors (e.g. Bannerman, 2008; Cervone, 2011; Serrador & Pinto, 2015; Inayat et al., 2015; Abrahamsson et al., 2002) agile project management does increase productivity, the quality of projects, the management's ability to evaluate ongoing projects, while it also entails a higher chance of success in the projects. All these reasons should surely increase the value of the company. This also much reflects what Bowman and Hurry (1993) mean when they argue that managers should view their opportunities through the real option lens. As presented, the case company worked in sprints where they reflected biweekly on the ongoing projects and how to move these along. This included discussions on what was working and what was not working as well as the outlook for the projects. Thus, we argue that this can be defined as part of the RM activities of the firm. Furthermore, they also discussed and reflected biweekly on whether the projects could, or should, be expanded upon or shut down. This very

closely mimics the options to expand, contract, and to salvage the options, in accordance to real option theory. This helps to fairly showcase the actual risk in the projects and the managerial flexibility in the company (Newton et al., 2004). Thus, the values of these options have been used to represent the value of the RM activities.

As mentioned, the RM premium was substantial in our calculations, increasing the value of the business with a factor of 4.17x. Since we got a similar value from both the MC simulations and the B&S calculations, we assume our valuation from the binomial trees to be robust. As mentioned, many aspects of the agile project management should increase the value of the company. Both Stultz (1996) and Brustbauer (2016) argue that RM decreases costly lower-end tails, and Raz et al. (2002) find that RM increases the likelihood of success. Hence, *ceteris paribus*, the value of a company with RM should be higher than that of one without it.

6. Conclusions

We here conclude our findings and reflect upon the potential limitations of the study. Lastly, we provide suggestions for future research given these limitations.

The research question we sought to answer was: “How do entrepreneurs handle risk and uncertainty in the projects they enter and what value does this create for the company?”, it was investigated via a case study where continuous observations, interviews, and reviews of strategic documents were conducted. We found that while the entrepreneurs did not feel like they were taking on any palpable risk, they acted like as if they were knowingly taking on substantial amounts of risk. Our findings go against previous literature that has found that entrepreneurs are risk lovers who knowingly and willfully embrace risk. However, the specific risks listed by previous literature, such as those of both Liles (1974) and Cacciotti and Hayton (2015), does not apply to our studied entrepreneurs. Instead, our findings indicate that being a VC backed entrepreneur might have more similarities with being an employed manager, than with being a traditional, self employed entrepreneur, since many of the risks that would otherwise be undertaken personally by the entrepreneur are now taken by an external shareholder.

Our case company is still young but is growing and maturing, and in the same time learning how to manage risks and potential failures. While they were not specifically thinking in terms of RM, they were certainly acting in terms of RM. The company was actively managing risks in

the projects they were in and when choosing future paths, and they did so in accordance to much of the presented literature.

We found that RM had a large impact on the value of the company, and because of the RM activities the company could enjoy a RM premium in their current valuation. This is in accordance to what previous literature shows. However, in our case we were able to quantify this value and show that the discrepancy between the value with and without RM was significant. But on the other hand this was also expected, since the case company was facing substantial risks. The value with RM was checked for robustness against both MC simulations and a B&S valuation, and were found to be reliable.

To answer the research question, in our case the entrepreneurs actively and continuously handled the risks they were facing by continually following up and monitoring the performance and development of the projects. We found that this increased the value of the company with a factor of 4.17x.

6.1 Limitations, reflections, and criticism

For us to achieve the purpose of this study, as well as the three research objectives, some major limitations have been discovered and need to be considered by any reader of this report.

Although a case study is believed to be the best method to understand how and why something is the way it is, a clear limitation is that it prevents us from drawing any general conclusions from the findings. Hence, the conclusions and findings of this study may not be representative for other companies and entrepreneurs and should therefore not be viewed as such. To be able to draw conclusions for entrepreneurs and startups in general, a larger collection of similar studies is needed. This study is therefore meant to be viewed as a small piece in the larger puzzle that is the mind of innovative entrepreneurs.

A second limitation is that we have studied a young and non-publicly traded company. Thus, our valuation cannot be benchmarked with any valuation made by a liquid market or equity research analyst. Instead, we can only check the robustness of our valuation by comparing to other valuations performed by ourselves using other methods. This means that our study is more exposed to any potential biases we as researchers might have, than it would otherwise have been.

A third limitation is that we are dependent on the information provided to us by the case company. While we do recognize that we in fact have a very good insight into the

business we also want to highlight that our dependence to the information given is in itself a limitation to the study. As we discovered in section “4.1 Selecting new projects”, the company has faced trouble due to biases in their market research before, and there is no guarantee that such biases have not affected the information used in this study. This means that the study is not only exposed to our own biases, but potentially also to any biases within the case company.

We also find it worth mentioning that in our case, it is not impossible that the calculated value without RM might be estimated too low and that the actual discrepancy between the two calculations is lower. As we saw in Figure 3, the expansion factor has a large impact on the valuation and since this is not included in the valuation without RM, this could explain the large discrepancy between the two valuations. However, we know that in our case company the risk is high as it is young and still has a somewhat untested business model. They are also, as of now, dependent on gaining external capital in order to survive. Thus, it is much more important for them to spend their money wisely as they now cannot rely on internally raised capital, and need to motivate potential investors by not only showing future potential but also historic improvement. Hence, in our case it makes sense that the value of the RM is high. However, to simply exclude the options within the projects might not be the best way to faithfully value the company without RM. Since our goal is not to value the company without RM but rather to

show the value premium a company can enjoy with RM, we still argue that our approach is valid since the options closely mimic the RM activities of our case company. We can therefore show that RM is of value in accordance to our model. However, we cannot prove that other companies might enjoy the same RM premium as our case company can.

6.2 Future research

Given the mentioned limitations, we want to emphasize a few suggestions for future research that we find valuable in order to both tweak and complement our study. First and foremost, since we have performed just one case study, more studies of entrepreneurs and their ways of managing risk is desirable before general conclusions can be drawn.

We also argue that it would be of high interest to investigate if differences in risk propensity and risk management can be found between entrepreneurs that are backed by VC firms and those who are not. This is since we believe that one reason to why the entrepreneurs behind our case company argued that they had not taken large financial risks, is specifically due to fact that the company is VC funded. It is reasonable to argue that running businesses with external shareholders has many similarities no matter the type of shareholders, and that running a business alone is much different. It is also reasonable to believe that an entrepreneur who invests and risks his/her own money is likely to have a higher propensity for risk-taking than someone who risks the

capital of institutional investors, who he/she may have a more anonymous relation to. Both more case studies similar to ours, as well as thorough analyses of larger datasets containing information about entrepreneurs with different types of funding and their respective risk-taking are therefore wanted.

In our model we have made a very simplified distinction between the company with and without RM. Future research could focus on better refining how RM activities could be defined and included, as well as excluded, from a valuation model in order to more precisely distinguish the potentially added value from those activities. Since previous literature has argued that the ROA could be very useful for managers when choosing projects, such a model could help managers make more well-informed decisions. Much like the ROA is argued to better showcase the true value of a project, and help managers not to deselect projects that the DCF-model would give a negative value, a ROA with more defined data inputs for RM activities could help managers make more well-informed decisions, especially for companies with high focus on R&D. With more refined RM aspects of the model, it could better be analyzed when the added RM costs would provide a net added value to the projects.

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Appendix

Questions to the CTO

- Review of how the projects are set up and divided (sprints)
- How are the teams selected for different projects?
- How do you choose which projects to implement?
- How do you choose to abandon projects?
- How involved are you and the CEO in the projects? When they are selected, implemented and completed.
- Has any project changed direction?
- Has any project been shut down completely?
- Have you always worked like this or what had to change for you to choose this way?
- How do you test new add-on services and updates for the system?
- How are the tests analyzed and assessed?

Questions to the CEO

- How is the ownership of the company distributed?
- What type of shares does the VC own? (preferred stock, convertibles or common stock?)
- How is the capital inflow divided, all at once or a little at a time? (Of the amount invested)
- If little at a time: Is there a condition that must be fulfilled in order for capital to be added at each occasion?
- Can the company seek new capital from elsewhere, or does the VC take precedence?
- Who sits on the board?
- How involved is the board in the operations? Which decisions must be approved by the board?
- Describe the distribution of voting rights / cash flow rights / other rights

Appendix 1. Interview questions to the CTO and CEO

The firm as on project

Number of shares	6 114 974,00	Amount of outstanding options	0,00
Price per share	0,79	<u>Option Value</u>	<u>0,00</u>
Dividend per share	0,00	Value of equity options issued	0,00
Total dividend	0,00		
Key factors for firm		Operating income	1 209 101,38
Total Market Value (MV)	4 836 405,53	<u>Netsale</u>	<u>2 129 817,41</u>
Total Book Value (BV)	3 364 089,63	Operating margin 2018	56,77%
Book to Market ratio	69,56%	Market growth	2,00%
Market to Book ratio	143,77%		
Amount of debt	0,00	Working capital Q1 2019	1 277 175,45
MV of debt	0,00	<u>Sales 2018</u>	<u>2 129 817,41</u>
Amount of equity	1 277 173,82	Working capital as percentage of revenues	59,97%
MV of equity	4 836 405,53	Debt grade	0,00%
Debt/equity ratio	0,00%	Equity grade	37,96%
Current Assets 2018	1 821 037,06	EBIT	1 209 101,38
<u>Current Liabilities 2018</u>	<u>1 415 892,19</u>	<u>Total Assets - Current Liabilities</u>	<u>1 277 175,45</u>
Working Capital 2018	405 144,87	Return on capital in perpetuity	94,67%
Current Assets Q1 2019	3 364 089,63	CAPEX	0,00
<u>Current Liabilities Q1 2019</u>	<u>2 086 914,19</u>	<u>Depreciation</u>	<u>0,00</u>
Working Capital Q1 2019	1 277 175,45		
Change in Working Capital	215,24%		
Change in Working Capital Q1 2019	872 030,58		
Expected WC-change 2019	3 488 122,30		
Total tangible assets Q1 2019	0,00		
Total tangible assets 2018	0,00		
<u>(+) Depreciation Q1 2019</u>	<u>0,00</u>		
CAPEX	0,00		
Cash and bank	2 220 265,19		
<u>Current investments</u>	<u>0,00</u>		
Cash and marketable securities	2 220 265,19		

Appendix 2. Outtakes from the financial statements that are used in the calculations

INPUTS FOR VALUATION

Current Inputs	
Enter the current revenues of the firm =	2 129 817,41
Enter the current operating income of the firm =	1 209 101,38
Enter the current capital expenditures =	0,00
Enter the current depreciation for the firm =	0,00
Enter the change in Working Capital in last year =	872 030,58
Enter the value of the current debt outstanding =	2 086 914,19
Cash and Marketable Securities at the firm =	2 220 265,19
Value of equity options issued by the firm =	0,00
Enter the number of shares outstanding =	6 114 974,00

High Growth Period	Inputs
Enter the growth rate in revenue for year 1 =	60,00%
Pre-tax operating margin year 1-5 =	30,00%
Enter the pre-tax operating margin you expected your firm to have in year 6 =	20,00%
How much debt do you plan to use in financing investments?	0,00%
Enter the growth rate in capital expenditures & depreciation	0,00%
Enter working capital as a percent of revenues	59,97%
Enter the tax rate that you have on corporate income	22,00%
What beta do you want to use to calculate cost of equity =	1
Enter the current long term bond rate =	0,39%
Enter the market risk premium you want to use =	15,10%
Enter your cost of borrowing money =	0,00%

Stable period	Inputs
Enter the growth rate in revenues =	2,00%
Enter the pre-tax operating margin in perpetuity =	17,00%
Return on capital in perpetuity for the firm =	94,67%
Enter capital expenditures as a percent of depreciation in this period	0,00%
How much debt do you plan to use in financing investments?	0,00%
Enter interest rate of debt in stable period =	0,00%
What beta do you want to use in stable period?	1

ESTIMATED CASHFLOWS	2018	2019e	2020e	2021e	2022e	2023e	2024e	2025e	2026e	2027e	2028e
	Base	1	2	3	4	5	6	7	8	9	10
Growth in Revenue		60,00%	48,40%	36,80%	25,20%	13,60%	2,00%	2,00%	2,00%	2,00%	2,00%
Growth in Depreciation		0,00%	0,00%	0,00%	0,00%	0,00%	0,40%	0,80%	1,20%	1,60%	2,00%
Revenues	2 129 817	3 407 708	5 057 038	6 918 029	8 661 372	9 839 318	10 036 105	10 236 827	10 441 563	10 650 395	10 863 403
COGS											
% of Revenues	70,00%	70,00%	70,00%	70,00%	70,00%	70,00%	80,00%	80,00%	80,00%	80,00%	83,00%
(c)COGS	1 490 872	2 385 395	3 539 927	4 842 620	6 062 960	6 887 523	8 028 884	8 189 461	8 353 251	8 520 316	9 016 624
EBIT	638 945	1 022 312	1 517 112	2 075 409	2 598 412	2 951 796	2 007 221	2 047 365	2 088 313	2 130 079	1 846 778
Tax Rate	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%	22,00%
Net Income (Ebit*(1-t))	498 377	797 404	1 183 347	1 618 819	2 026 761	2 302 401	1 565 632	1 596 945	1 628 884	1 661 462	1 440 487
(+)Depreciation	0	0	0	0	0	0	0	0	0	0	0
(-)CAPEX	0	0	0	0	0	0	0	0	0	0	0
(-)Change in WC	3 488 122	500 000	500 000	500 000	500 000	500 000	500 000	500 000	500 000	500 000	500 000
FCFF	-2 989 745	297 404	683 347	1 118 819	1 526 761	1 802 401	1 065 632	1 096 945	1 128 884	1 161 462	940 487
Terminal Value (last period)											7 018 561

COST OF EQUITY AND CAPITAL	2018	2019e	2020e	2021e	2022e	2023e	2024e	2025e	2026e	2027e	2028e
Cost of Equity	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%
Proportion of Equity	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
After-tax Cost of Debt	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Proportion of Debt	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
WACC	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%	15,40%
Cumulative WACC	1,1540	1,3317	1,5368	1,7735	2,0466	2,3618	2,7255	3,1452	3,6295	4,1883	

Present Value	257 715	513 133	728 018	860 890	880 688	451 204	402 480	358 924	320 002	1 675 676
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FIRM VALUATION

Value of the Firm	6 448 731
(+) Cash & marketable securities	2 220 265
(-) Value of Debt	2 086 914
Value of Equity	6 582 082
(-) Value of Equity options issued	0
Value of Equity	6 582 082
Value per share	1,08

Appendix 3. Inputs for the valuation

Introduction	Project	Expected revenue/v	# employees needed	Expected operating cost	Operating profit per project	Cumulative WACC	sNPV
2020	Add-on Service 3	86 538 944,10	5	4 081 459	82 457 484,67	1,5031	54 859 158,60
2020	Add-on Service 6	97 545 919,91	15	12 244 378	85 301 541,64	1,5031	56 751 316,39
2021	Add-on Service 2	8 653 894,41	10	8 162 919	490 975,56	1,8428	266 433,28
2021	Add-on Service 5	68 453 277,13	5	4 081 459	64 371 817,70	1,8428	34 932 073,25
2021	Add-on Service 1	5 125 145,80	5	4 081 459	1 043 686,38	1,8428	566 367,86
2021	Add-on Service 4	63 747 114,33	5	4 081 459	59 665 654,90	1,8428	32 378 222,36

Project name	Launch date	Likely # of users	Possible	Expansion factor	Expansion costs
Expansion					
Add-on Service 3	2020		284	1,25	4 081 459
Add-on Service 6	2020		2 431	2,67	12 244 378
Add-on Service 2	2021		1 658	2,50	8 162 919
Add-on Service 5	2021		2 920	1,67	4 081 459
Add-on Service 1	2021		9 805	1,00	4 081 459
Add-on Service 4	2021		721	2,50	4 081 459
Contraction					
				Contraction factor	Contraction gain
Add-on Service 3	2020			0,83	4 081 459
Add-on Service 6	2020			0,83	12 244 378
Add-on Service 2	2021			0,83	8 162 919
Add-on Service 5	2021			0,83	4 081 459
Add-on Service 1	2021			0,83	4 081 459
Add-on Service 4	2021			0,83	4 081 459
Abandonment					
				Salvage value	
Add-on Service 3	2020				0
Add-on Service 6	2020				0
Add-on Service 2	2021				0
Add-on Service 5	2021				0
Add-on Service 1	2021				0
Add-on Service 4	2021				0
sNPV (project based)					
		Introduction year		sNPV in millions	
Add-on Service 3		2020		54 859 158,60	
Add-on Service 6		2020		56 751 316,39	
Add-on Service 2		2021		266 433,28	
Add-on Service 5		2021		34 932 073,25	
Add-on Service 1		2021		566 367,86	
Add-on Service 4		2021		32 378 222,36	
Contraction factor					
Full capacity			1		
Number of projects			6		
Capacity for each project			0,17		
Contraction factor for each project			0,83		
Abandonment					
		2004		2005	2006
Salvage value (one project)		0		0	0
Interest rate		0			
Effective rate		0			
Dividend					
Dividend per share		0,00			
Price per share		0,79			
Dividend yield		0,00			
Other factors					
Volatility		40,55%			
sNPV		10 450 680			
Time to maturity		2			
NPV (project based)					
		Revenue	Number of users	Revenues per user	
	2018	3 451 538	82 650	41,76	
	2019e	5 522 461	115 061	48,00	
	2020e	8 195 333	199 331	41,11	
				43,62	

Appendix 4. Input for options

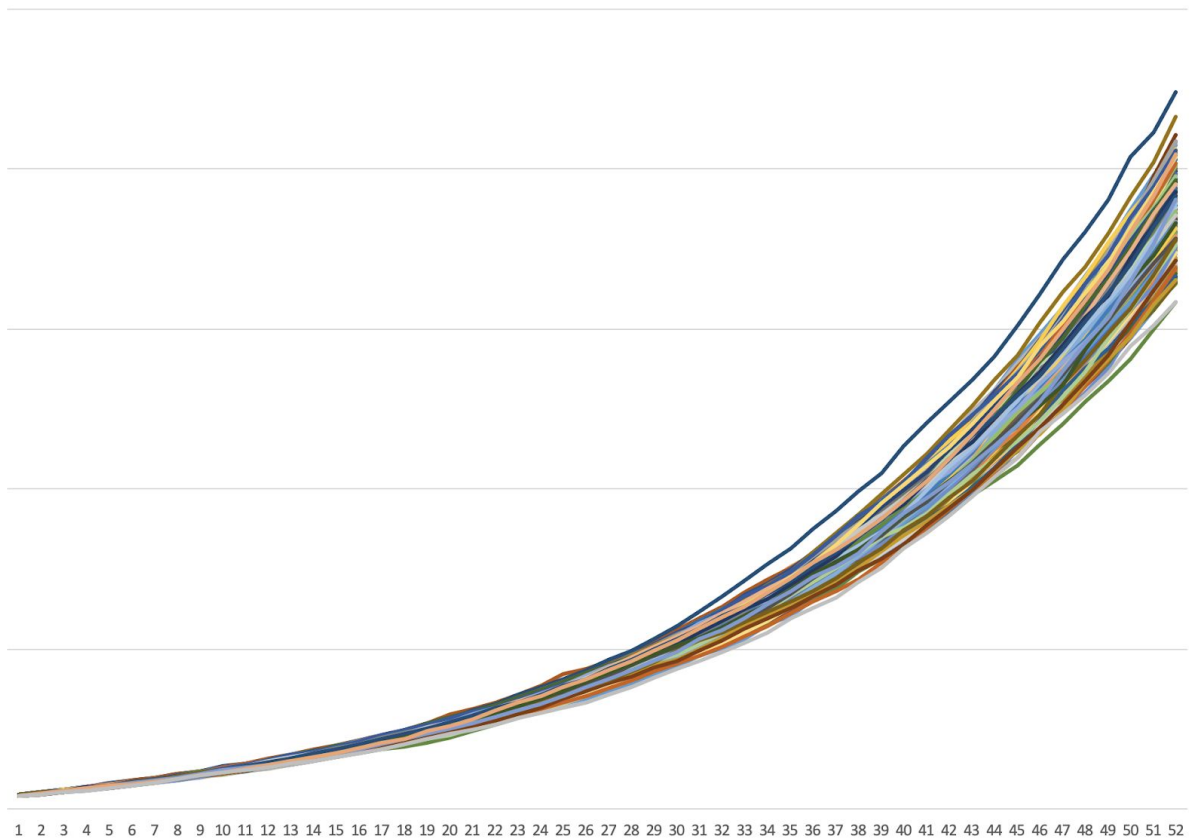
Inputs	
Underlying Asset Value Now (S0)	54 859 158,60
Standard Dev - Annual (Std)	40,55%
Riskfree Rate - Annual (rf)	0,30%
Exercice Price (X)	20 407 297,12
Time to Maturity - Years (t)	2,00
Binominal steps - Years (dt)	0,04
Expansion factor	2,02
Expansion Costs	4 081 459,42
Contraction factor	1,35
Contraction Savings	4 081 459,42

Output	
Growth Rate (R)	
Up Movment/Period (u)	1,081605
Down Movement/Period (d)	0,924552
Risk-neutral Probability (p)	0,520347
1-p	0,479653
Option Premium	94 550 289,91

Appendix 5. Basis for the option calculations

Time Period	Date	Cash flow	Relative Returns	Logarithmic Returns
1	dec 2016	-239 803,63		
2	jan 2017	-356 802,98	1,487896522	0,172572729
3	feb 2017	-268 523,54	0,752582096	-0,123446118
4	mars 2017	-317 584,96	1,182708092	0,072877568
5	apr 2017	-321 247,47	1,011532377	0,004979788
6	maj 2017	-420 977,93	1,31044746	0,117419613
7	juni 2017	-440 095,91	1,04541325	0,019288
8	juli 2017	-974 410,68	2,214087131	0,345194708
9	aug 2017	-792 696,73	0,813513994	-0,089634972
10	sep 2017	-1 112 518,09	1,403459922	0,147200015
11	okt 2017	-1 136 144,52	1,021236894	0,009126496
12	nov 2017	-1 572 650,84	1,384199648	0,141198735
13	dec 2017	-2 373 607,66	1,509303656	0,178776624
14	jan 2018	-1 689 235,33	0,711674197	-0,14771878
15	feb 2018	-1 358 215,76	0,80404177	-0,094721389
16	mars 2018	-1 711 592,84	1,260177424	0,100431695
17	apr 2018	-1 991 411,82	1,163484544	0,065760619
18	maj 2018	-1 676 575,36	0,841902888	-0,074738001
19	juni 2018	-2 060 536,01	1,22901485	0,08955713
20	juli 2018	-2 479 109,01	1,203137916	0,080315413
21	aug 2018	-2 860 794,37	1,153960701	0,062191019
22	sep 2018	-2 112 590,65	0,73846295	-0,131671289
23	okt 2018	-2 580 127,83	1,221309878	0,08682587
24	nov 2018	-2 946 908,72	1,142156093	0,057725461
25	dec 2018	-2 827 433,12	0,959457312	-0,017974343
Volatility of the Period				11,71%
Annualizing Volatility				40,55%

Appendix 6. Estimation of volatility



Appendix 7. Chart of the Monte Carlo Simulations for all options

Indexed Output	Monte Carlo	Binomial Tree
Mean	114,34	100,00
Median	79,24	100,00

Appendix 8. Output from the Monte Carlo Simulation compared to the Binomial Tree