Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Department of Economics

Two investment solutions for CTL forestry machines

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Master's thesis · 30 hec · Advanced level
Agricultural Programme – Economics and Management
Degree thesis No 993 · ISSN 1401-4084
Uppsala 2016

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Credits: 30 hec
Level: A2E
Course title: *Independent project/degree in Business Administration*
Course code: EX0536
Programme/Education: Agricultural Programme - Economics and Management
Faculty: Faculty of Natural Resources and Agricultural Sciences

Place of publication: Uppsala
Year of publication: 2016
Name of Series: Degree project/SLU, Department of Economics
No: 993
ISSN 1401-4084
Online publication: http://stud.epsilon.slu.se

Key words: *Leasing, Forestry Machines, Instalment loan, CTL, Breakdown*

SLU
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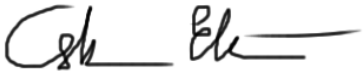
Department of Economics

Acknowledgements

Firstly, I would like to thank the different experts that have helped me gain a deeper understanding of the field of research and all its different puzzle pieces. Without these people the puzzle would never have become complete.

Secondly, I would like to thank my supervisor Hans Andersson at the Department of Economics, at the Swedish University of Agricultural Sciences, for your guidance along the rocky path of this thesis. Your great knowledge of so many different areas and your vast experiences have made your inputs on this thesis invaluable.

I would also like to send a warm thank you to my family and friends for their endless support and never-ending advices. And lastly but not least I would like to thank Emelie who always believes in me and always seems to have a solution for everything.



Oskar Eliasson

Abstract

The private owned forestry machinery contractors account for the major part of the harvesting and logging of wood in Sweden. Without contractors the Swedish forestry sector would not be able to harvest any wood in the Swedish forest. A large group of the contractors have struggled with poor liquidity since the nineties. In a sector with low profitability, it is important to make every investment decision in a balanced way and by the right time. If you sell the machine too early you might end up with high financial costs, if you sell to late you might end up with a machine that causes a lot of unwanted downtime and costs.

This thesis' aim is therefore to examine, with the help of a questionnaire and mathematical calculation, if it is more profitable to loan money for a new forestry machine or lease it. To reach the aim this study is carried out through a quantitative manner by both using questionnaire and calculations. In order to obtain data for the calculations the author first conducts a questionnaire to gather information about contractors and their machinery. The results from this survey are then used in order to do correct and truthful calculations. Finding the most economically rational time to replacement for a machine is conducted through a mathematical method based on net present value calculations of annual costs. By using the optimal time for investing in a new machine, a comparison between bank loan and leasing is conducted in order to find which the most economically rational financing solution is.

Results from the study show that contractors own their machinery for a time length a bit too short, compared with the most economically lifespan. Only half of the contractors reveal that they do not conduct any calculations of their own, before investing, or take in bids and offers from different vendors before purchasing a new forestry machine. Bank loan appear to be the better option from an economic perspective, but leasing has other advantages that a normal bank loan does not have in form of risk-taking and flexibility.

Sammanfattning

De privatägda skogsmaskinentreprenadföretagen står för den största delen av avverkningen och skotningen av timmer i Sverige. Utan entreprenörerna skulle den svenska skogssektorn inte kunna avverka några större volymer av timmer i den svenska skogen. En stor grupp av entreprenörerna har kämpat med dålig likviditet sedan nittiotalet. I en sektor med låg lönsamhet är det verkligen viktigt att varje investeringsbeslut sker avvägt och vid rätt tillfälle. Om man säljer maskinen för tidigt kan man sluta med dyra bankkostnader men om man säljer för sent kan man sluta med en maskin som orsakar alltför många oönskade driftstopp och höga kostnader.

Studiens mål är därför att se, med hjälp av ett frågeformulär och matematiska beräkningar, om det är bättre att låna pengar till en ny skogsmaskin eller att leasa maskinen. För att nå målet med denna studie genomförs den på ett kvantitativt sätt med både frågeformulär och egna beräkningar. För att få underlag för beräkningarna genomför författaren först en enkät för att samla information om entreprenörer och deras maskiner. Resultaten från denna undersökning används sedan för att göra korrekta och sanningsenliga beräkningar. Att hitta den ekonomiskt mest rationella tidpunkten för att byta en maskin sker genom en matematisk metod baserad på nettonuvärdesberäkningar av de årliga kostnaderna. Efter att ha hittat den optimala tiden för nya investeringar används dessa resultat för att beräkna och jämföra vilken metod av banklån eller leasing som är den mest ekonomiskt rationella finansieringslösningen.

Resultat från enkäten visar att entreprenörerna äger sina maskiner under en lite för kort tidslängd, jämfört med det mest ekonomiskt rationella alternativet. Endast hälften av de responderande entreprenörerna säger att de inte genomför några egna beräkningar innan de investerar eller tar in anbud från olika leverantörer innan de köper en ny skogsmaskin. Banklån verkar vara det bättre alternativet, rent ekonomiskt, men leasing har andra fördelar som ett vanligt banklån inte har.

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1 Introduction

This introductory chapter presents the basis for the study. It begins with a short presentation of the problem background, which the problem formulation is then based on. From the problem originates the aim at this study is defined.

1.1 Problem background

Any firm needs to know the possible known consequences in order to make a good investment decision (Löfsten, 2002). Making a good investment decision is often difficult since it is often associated with a great deal of uncertainty and the investment often extends over a very long period of time (Skärvad & Olsson, 2008). That is why a company always should evaluate the investment before making any decisions (Zavrl, 2008). One way of evaluating an investment, or financial decision, is by using techniques of investment appraisal (Lee *et al.*, 1999). They add objectivity to the decision process but one has to always collect and analyse relevant data.

Any investment made should be in line with the strategic goals of the company (Ljung & Högberg, 1999). The pros and cons with each investment alternative need to be weighed against the main goals of the company. Another part of the investment decision process is to assess the risks involved (Grubbström, 2005). Different investment types offer different levels of risk. One type of investment may look good on paper, but in reality it may be associated with a great deal of risk. This is why planning investments in a company is essential (*ibid*.).

One sector in Sweden where large investments represent a major part of every company is the forestry sector (Skogsindustrierna, 2012). This sector plays a fairly large vote in the Swedish economy, even today. In year 2012 forestry industry accounted for 0.7 percent of the GNP (Lantbrukarnas Riksförbund, 2012). When compared with the entire Swedish industry sector forestry sector represent for 12 percent of the turnover, 9 percent of added value and 11 percent of total employment (Skogsindustrierna, 2012).

The profitability in the Swedish forestry sector has been and, still is generally good, compared to other sectors (Skogsindustrierna, 2013). The introduction of electronic devices though has lowered demand for printing- and newspaper (Statistiska centralbyrån, 2013) and the financial crisis in year 2009 had lowered demand for construction wood around the world (Skogsindustrierna, 2013). In U.S. the number of housing starts went from over 2 million in 2006 to under 1 million in end of 2009 (The Congress of the United States, 2008; U.S. Department of Commerce, 2014). A similar situation emerged in United Kingdom, an important market for the Swedish forestry sector (Homes and Communities Agency, 2013; Statistiska centralbyrån, 2013).

These market changes for the sector has forced many forestry companies to enact major cost savings in both manufacturing and administration of their organizations (Skogsindustrierna, 2013). During the both year 2012 and 2013 Swedish forestry industry was forced to shut down both pulp- and saw mills due to lower demands in the world market.

A lower demand for both saw timber and news print paper have forced forestry companies to pay less for the round wood (Skogsstyrelsen, 2013). Due to these lower prices the suppliers willing to sell has decreased dramatically, especially in south part of Sweden where most of the private forestry owners are to be found. This has created a dilemma for forestry

companies. They still face demand for wood for their industries, but they cannot afford to raise the prices to their suppliers. Since the harvesting of trees can be stretched beyond the time when the forest reaches the financial optimum in age, many private forest owners have decided to postpone their logging until prices go up (*ibid*.). Private owners represent around 50 percent of all forest owners in Sweden, and therefor they have a major role as suppliers to the Swedish forestry industry.

Most of the raw material for the forestry sector is harvested in Swedish forests (Skogsstyrelsen, 2013). Nearly all of Sweden's raw material for the forest industry is harvested by mechanised contractors (Häggström *et al.*, 2013). Most of the industry therefore depends on self-dependent contractors to carry out logging and other silviculture operations as of today. But some large industrial companies still own their own forestry machinery.

During the mid-sixties and seventies it was common that the large forestry companies owned the forestry machinery themselves (Hultåker *et al.*, 2003). However, in the late seventies and the early eighties the forestry companies began to outsource the logging services. The main goal was mainly to reach improve profitability within the own company. Due to outsourcing the market for logging services expanded during the seventies, eighties and nineties. During this transformation period the forestry companies offered their personnel to buy the logging machinery from the company but they continued to be employed by the company. This special way of employment was called "AT-driver" or "employee drivers". In the mid-eighties forestry contractors owned 32 percent of the logging machinery, 29 percent were AT-drivers and the rest of the machinery were still owned by forestry companies. In the mid-nineties the numbers had change to over 70 percent owned by contractors and 6 percent owned by AT-drivers. Today the AT-drivers are more or less a part of the history (Skogsstyrelsen, 2013). Many companies are "one-man" companies, but the large majority of the forestry workforce is found in small-sized companies that employs between two and nine persons (Häggström *et al.*, 2013). Most of the forestry contractors are working for one or a few large forestry companies (Hultåker, 2006).

The profitability of the Swedish forestry contractor firms has been poor ever since the 1990's (Hultåker, 2006). One reason for the financial challenges is the need to investing in expensive machinery (Häggström *et al.*, 2013). Historically the excessive investments in harvesters could more or less be explained by rapid technological improvement (Nordfjell *et al.*, 2010). The same doesn't apply for forwarders. The forwarders are less complex in their technology and an investment in a newer machine due to new technology is therefore more difficult to motivate. The past decade there has not been any great leaps in technological development of either harvesters or forwarders, which has interfered with efficiency developments (*ibid.*). With new environmental certification standards that the industry demands new challenges has emerged for the entrepreneurs. They need to adapt their procedures while maintaining efficient workflows. This has led to rising harvesting costs and a reduced production rate per machine.

An article in the newspaper ATL (Lantbrukets Affärstidning) state that the forestry contractors need to obtain full control over the company's finances in order to make the right decisions for the future and be successful (Andersson, 2010). In the year of 2010, an interview study with ten successful and profitable Swedish forestry contracting entrepreneurs (Norin, 2010). Despite of their successfulness few of them took time and made the effort in evaluating an investment before making a decision. Some of the interview objects stated that they operated the company with "gut feeling" rather than conscious economical evaluation

technics. According to the study, they had different types of strategies when to trade forestry machinery. Some choose a type of leasing with repairs and maintenance included and some chose to do parts or all of the repairs and maintenance themselves. No one of the interviewed entrepreneurs explain why they were actually successful (*ibid*.).

1.2 Problem

Machinery owning contractors need to make large investments in both machine and educated personnel (Häggström *et al.*, 2013). Purchasing new machines require long-term contracts to secure the amount of work needed to recoup the investment (Soirinsuo & Mäkinen, 2009). Because of large capital posts, it is critical that both resources are used as efficient as possible (Häggström *et al.*, 2013).

The forestry machines represent a major part of the asset of the company for the forestry contractor. Without the machines, the contractor is not able to carry out the work. In a small forestry contractor company with two employees you often have two forestry machines; one harvester and one forwarder (Häggström *et al.*, 2013). Since the equipment is expensive and they are essential for the company, they need to operate both cheaply and with as few breakdowns as possible. To buy and own a machine for an extended period may lead to a low capital cost per year but the risk for expensive breakdowns and necessary repairs may increase. Leasing a machine during a shorter period of time may result in a more reliable operation when repairs are included but the costs may be higher.

In a study made by Norin (2010), it is found that some of the contractors have poor or a low interest in investment calculations. The problem in itself isn't really the fact if the contractors can afford new machine – it is to make the economically motivated investment with as few resources consumed as possible without facing any loss of quality or performance.

1.3 Aim and research questions

The aim of this thesis is to explore and evaluate the most cost efficient investment solution for an investment in forestry machinery in a forestry contracting business by comparing the investment financing alternatives leasing and instalment loan. To reach the aim the author explores the following research questions.

* Which investment solution of leasing or an instalment loan is the most cost efficient?
* Which is the most economically rational timespan to replace forestry machine and reinvest in a new machine?
* Do Swedish forestry contractors more commonly use either financing alternative?

1.4 Delimitations

This thesis only examines machine-owning contractors. Hence, the author intends to explore a branch, within the forestry contractor sector, that faces both excess capacity of machinery and a large labour costs.

The calculations only examine one typical large-size forest harvester and one large-size forwarder. The machines are cut-to-length machines (CTL), which is the most common system used in Sweden. This limitation implies that the developed model only will be representable for this size of machines. Larger and smaller types of machines have different operating costs and a different price range for spare parts. Large CTL-machines are also

almost exclusively used for final harvesting. Final harvesting is a system with a more uniform production volume than thinning that makes the analyses more precise.

1.5 The Cut-to-length system

In Europe and many other parts of the world forests are harvested mechanically through a system called Cut-To-Length (CTL) (Einola, 2013). The CTL-system normally consists of two types of machines: one harvester and one forwarder. The CTL-harvester, as seen in Figure 1 (frame 1), is used for cutting and felling the trees in specific lengths, delimbing and finally cutting off the tree stems (*ibid.*). The harvester normally leaves the cut-to-length trees where they fall. After the harvester comes the forwarder who's task, as depicted in Figure 1 (frame 2 and 3), is to collect the cut-to-length wood lying in the forest and to transport it out to the road-side where a lumber truck (frame 4) collects the wood and transport it to industries (*ibid.*). The other commonly used system is called tree-length (TL) (Klase & Steel, 2011). This system often requires several individual machines: feller, skidder, loader and processor. The feller cuts and fells the tree and the skidder then drags full-length trees to the loader, which is "feeding" the processor. This type of system is efficient when only one type of wood category is processed (*ibid.*). The downside is that it consumes much more fuel than the CTL-system due to a larger number of machines.

Figure 1. The CTL system consisting of one harvester and one forwarder,

2 Background

This chapter presents some relevant background information needed to comprehend the study.

2.1 Leasing

A leasing contract is a contract between a lessor and a lessee. Leasing is a lending method for companies to lend founds to other companies or individuals (Hansson, 1998). In other words, a company rents a product from a bank, specialized leasing company or direct from the manufacturer (Hansson, 1998). The leasing contract has a time-restricted date with a fixed sum paid monthly to the leasing company. There are two main types of leasing: financial and operational leasing. Leasing transfers most of the risk associated with owning expensive equipment from the lessee to the lessor (Quiry & Vernimmen, 2011).

2.1.1 Advantages and disadvantages with leasing

Leasing is often described as a more expensive form of financing than other alternatives (Yard, 2001). The main "competitors" to leasing is instalment purchase and loans with mortgage to be paid by the company. The greatest benefit for the lessee is that they are not required to physically purchase a machine. Hence the acquisition does not affect the company's balance sheet. The monthly fees are also fully tax-deductible (Adlercreutz & Pfannenstill, 2010). When choosing leasing as a form of investment financing it is normally simpler to obtain a higher level of self-financing because the capital investment is lower compared to other options (Yard, 2001). When a company leases a product they may replace it with a new one without jeopardising their own financial situation.

A major disadvantage with leasing is that the lessee has limited options regarding the periodization of payments (Yard, 2001). All leasing payments are connected to the financial costs for the same period. This can be compared to investing using a loan, where the company may decide when and how they want to conduct their depreciation. Another disadvantage is that leasing is not legally regulated (SOU, 1994). This may cause problems in legal disputes between the lessor and lessee.

2.1.2 Financial leasing

Financial leasing can be traced back to the 1950s USA (SOU, 1994). In Sweden it has been used for financing since the 1970s and is commonly used since the 1980s. This type of leasing is a strict financial leasing contract between two companies (Contino, 2002). The lessor does not maintain, or in any other way, repairs or services the product that they lease out. Financial leasing normally lasts for the products entire economic lifetime (Quiry & Vernimmen, 2011). Given an agreement with a lessee, the lessor orders the product from the manufacturer (Contino, 2002). When the product is manufactured the lessor acquires the product and becomes the official owner of the product. It is delivered to the lessee and the lessee then starts to pay the agreed fee for the product. The fixed payments should cover market value of the asset, the original cost for the product, administrative fees, compensate for the risk and a yield profit to the lessor-company (Adlercreutz & Pfannenstill, 2010; Quiry & Vernimmen, 2011).

2.1.2 Operational leasing

This type of leasing implies that the lessor often provides some type of non-financial service to facilitate the lessee's ability to operate the machine. In other words it is a combination of leasing and some kind of additional service (Contino, 2002; Adlercreutz & Pfannenstill,

2010). The type of services provided may for example be: repair, maintenance, support, advising and tailor made solutions. This type of leasing solution normally lasts for a shorter period than the economic life of a product (Quiry & Vernimmen, 2011). When the leasing contract is at an end the lessee normally has the option to purchase the product from the lessor. If the lessee chooses not to purchase the product from the lessor, the lessor normally sells the product at the market or leases it out to a new lessee.

2.2 Gross capital formation

One of the most common reasons for bankruptcy in the forest entrepreneur sector is that the entrepreneurs cannot pay the rent for their loans (Ager, 2014). There is a way to "hide" or postpone the loan-trap and it is to conduct something called gross capital investments. This type of deal is conducted when the entrepreneur replaces an old machine with a new one (Norin, 2010). The gross capital formation deal is conducted in such a manner that the entrepreneur receives a higher value for their old machine from the vendor than the actual market value of the machine. The overvaluation is conducted because entrepreneurs often maintain an accounting value for their machines that is higher than the actual market value. If the vendor pays the market value for an old machine the entrepreneur is forced to realize a capital loss when purchasing a new machine (*ibid.*). To avoid this situation the vendor pays a higher price for the old machine to bridge the gap between the market value and the accounting value. The vendor then adds that amount to the price for the new machine, which means that the entrepreneur pays more for than the retail price for the new machine. The deal does not, in reality, affect the dealer since he or she in the end receives their due amount (Norin, 2010). Gross capital formation maybe used to "solve" the problem an entrepreneur faces with not having sufficient liquidity to provide for the down payment of a new machine.

However, the higher cost for the new machine leads to higher loans and therefore higher level of amortization and interest expenditure for the entrepreneur. The new machine then provides even higher economic strains on the entrepreneur than the old machine. According to Norin (2010) it is most unlikely that the entrepreneur is capable of handling the even higher economical pressure if they were not able to handle the demands of the old machine. Gross capital investment is often just a way to postpone a bankruptcy (Norin, 2010). If an entrepreneur loses the contract and is forced to close down the business he or she has loans on their machinery in excess of the market value (Norin, 2010). During an economic recession entrepreneurs with a poor financial situation might face a scenario where they are not able to receive new bank loans. This may result in a situation where they are either forced to close down the company or use old machinery for a longer timespan than planned (Ager, 2014).

3 Literature review

This provides a broader sense of what literature that are found within the research area.

3.1 Forestry machinery usage and trading

According to a study made in Italy, Germany and Finland by Spinelli *et al.* (2011), forestry machines are used on an average 1 617 hours per year with a lower quartile span of 818 and upper of 2 416 hours. A few machines are used up to 4 000 hours per year. The authors of the study claim that the annual use in their study is a bit lower than earlier reports, which are based on time sheets and reported, scheduled time. This gap is explained by the fact that the machine is not productive for a full workday (*ibid.*). On a scheduled eight-hour workday the machine is productive for around seven of these hours.

The study by Spinelli *et al.* (2011) shows that professional contractors purchase new machines, which are later sold to smaller contracting businesses. The authors claim that there does not seem to be any reduction in the annual use even if the machines are older. Results also show that forestry machines are sold after being used between 2 800 and 17 800 working hours and most often after around 10 000 hours (*ibid.*). The economic life of the machines is assumed to exceed the top span of 17 800 hours.

Harvesters are normally sold age-wise when they are somewhere between 2 and 14 years (Spinelli *et al.*, 2011). The average age of such a machine when being sold is 7.8 years but some machines are still being traded on the market after more than 30 years. The less complex forwarders have a higher annual use, longer economic life and a higher residual value than the complex harvesters (*ibid.*). The lower complexity results in less wear and tear and as a result, a higher operational use.

Spinelli *et al.* (2011) propose through calculations in their study that harvesters should be sold after being used 10 000 hours and/or 8 years since new. The residual value is estimated to 30 percent of a new equivalent machine. Similar suggestions are made for forwarders but the residual value is 40 percent. The economic life for both machine types is, according to Spinelli *et al.* (2011) very likely to exceed 10 000 hours and may be around 18 000 hours.

According to the authors in Spinelli *et al.* (2011), it is difficult to obtain exact retail prices from machine vendors when conducting a study. They argue that each buyer receives a price from the vendor that is specifically designed for the company depending on the financial background of the company. The price that is official available from vendors is the list price (*ibid.*). The list price does not reflect the actual price the companies pay. Due to this fact, the study takes into account the list price of new machines.

3.2 Company growth

A study about economic and technic forces in dairy farms conducted by Hansson (2007) show that one of the most efficient ways to improve the financial state of a company is to minimize costs. Investing in machines increases the costs of a company (Soirinsuo & Mäkinen, 2009). However, in their study Soirinsuo and Mäkinen (2009) argue that capital investment requirements are substantial in the forestry sector. Investments do not only include machines but also well-educated and professional personnel capable of handling the machines. The study shows that a company's financial situation highly affects investment financing strategies and future financial growth.

The authors also argue that the growth of these companies' is important for the financial economy, employment rate and competitiveness (Soirinsuo & Mäkinen, 2009). Successful growth often brings good outcomes for both the entrepreneur and the company. Unsuccessful growth, on the other hand, may create an unprofitable medium-sized company out of a small profitable company.

If a company is in a weak financial situation it could be quite difficult to purchase new machinery. Soirinsuo and Mäkinen (2009) argue that borrowing money to purchase new machines, in a weak financial situation, is not a good way to improve the conditions for the company. They argue that although old and worn out machines often implies more expensive maintenance and added downtime for repairs borrowing money for growth is a bad strategy.

3.3 Leasing

A study by Khalil and Goitom (2009) concludes that leasing is an easy and convenient investment solution for small sized companies that does not have good liquidity. The authors also conclude that the main benefit with leasing is that the company knows future cash flows and do not invest capital by owning machines. In another Swedish study by Wahlström (2012) is based on interviews with companies with a solid financial situation and therefore no problems with self-financing. The study concludes that the companies' liquidity position has the largest impact on how a company chooses to finance their investments. If the company has a poor liquidity situation they tend to use leasing more often as a way of financing.

Some studies have been conducted concerning leasing within the farm sector. A study of 400 farmers in Nebraska, North America, by Grisso *et al.* (1988) describes what factors that have the largest impact on how farmers decide on whether to purchase and/or lease a new tractor. The authors conclude that three factors have the largest impact; what the dealer thinks about different investment solutions, how neighbours, friends and relatives do and what advertising information the farmer receive from machinery dealers.

In another American study by Dumler *et al.* (2010) different investment solutions, such as instalment loan; leasing; renting and custom hiring, are compared when investing in farm machinery. The authors conclude that when investing in a harvester the loan solution is more advantageous than leasing, due to by the tax system and different risk rates. However, they also argue that each alternative has advantages and disadvantages compared with other solutions.

Landry *et al.* (2013) argue that depending how a small company is owned - self-funded, family owned or small CEO Company – the use and approach to leasing varies. Lone funder companies tend to use leasing more often than CEO-owned firms. Family owned firms tend to use leasing when they want to expand without taking large risks. The study also shows that family owned firms with a high debt loan use leasing more often than non-family companies in same state.

3.4 Breakdowns

In 1975 Axelsson conducted a study concerning breakdowns and optimal service length on one of the first cut to length (CLT) machines, a Koehring Waterous machine. The Koehring harvester differs from a modern CTL-machine. For example, the Koehring machine was an "all-in-one" machine, which means that it preformed harvesting, and logging. By analysing

how the mechanical availability of a forest harvester is affected by the reliability of machines, Axelsson (1975) could calculate the Mean Time Between Failures (MTBF) and optimal Mean Time To Repair (MTTR).

A study recently conducted by Kováč *et al.* (2013) shows how MTBF decreases with increasing total operating hours. Kováč *et al.* (2013) state the importance of the forest machines' operating time being as high as possible versus the number of breakdowns, in order to achieve a good harvesting economy. The study is carried out on three CTL-machines; one small sized, one medium sized and one large-size during the years between 2005 and 2010. Each year the number of breakdowns is documented for each machine and later collected and summarized. The result is almost the same for the three machines; the failure intensity / operative time curve display a progressively increasing shape. Kováč *et al.* (2013) show in their study that there are no major differences in breakdown intensity between the smallest and the largest machine.

3.5 Summary

The study by Spinelli *et al.* (2011) collects data from different European countries. Although Finland has a lot of similarities with Sweden the results from similar studies may differ due to for example market structure and operation hours. It is therefore of relevance to explore the use of forestry machines in a Swedish context.

Dumler *et al*. (2010) compares different investment solutions and Grisso *et al.* leasing, but the studies concern farm machines, in North America. Farm machinery and forestry machinery are both quite expensive machines, but still rather different. Therefore it is of relevance to compare investment solutions for forestry machinery.

The two previous Swedish studies of leasing do not take the context of forestry machines into account but view the term machinery more generally. It is therefore relevant to explore if the results regarding leasing is applicable to the forestry sector or not.

The study by Hansson (2007) states that cost minimizing is a key to success. At the same time, Soirinsuo and Mäkinen (2009) state that capital investment requirements within the forestry sector are substantial, even though investing in new machinery increases the costs, and that a company's financial situation highly affects the choice of investment financing strategies. It is therefore of relevance to explore which investment financing strategy that is the most cost efficient.

Table 1 displays a summary of the literature review. No previous study has been conducted that compares leasing and instalment loans as an investment financing strategy within the Swedish forestry sector.

Table 1. Summary of literature review displaying field of interest and geographic location of each study

Study/article	Field of study	Geographic
Axelsson (1975)	Forestry machinery breakdowns	Sweden, Canada
Dumler *et al.* (2010)	Comparing investment solutions for farm machinery	North America
Grisso *et al.* (1988)	Leasing as an investment solution for tractors	North America
Hansson (2007)	Economic and technical forces on dairy farms	Sweden
Khalil & Goitom (2009)	Leasing as an investment solution for small businesses	Sweden
Kováč *et al.* (2013)	Forestry machinery breakdowns	Slovak Republic, Czech Republic
Landry *et al.* (2013)	Family firms and the lease decision	North America
Soirinsuo & Mäkinen (2009)	Financial growth within forestry sector	Finland
Spinelli *et al.* (2011)	Annual use, economic life and residual value of CLT-machines	Italy, Germany, Finland
Wahlström (2012)	Operational leasing in large businesses	Sweden

4 Theoretical Framework

This chapter presents the theoretical framework connected to the field of interest in this study.

4.1 Decision making

Decision theory is about how decisions are made (Nutt & Wilson, 2010). The most famous and widespread theory about the decision-making framework is created by Mintzberg *et.al.* (1976). Mintzberg's study viewed 25 strategic decision processes across a company's organization and displays that there are three main decision theories: the normative theory, the descriptive theory and the prescriptive theory (Mintzberg *et al.*, 1976). The normative theory describes how people should behave in order to make a rational decision, a golden example of how decisions should be performed (Bell *et al.*, 1988). The descriptive theory describes what people actually do and the prescriptive theory describes how people should make their decision but it also includes what they may do. The study by Mintzberg *et al.* (1976) also displays that a decision maker may use an intuitive or an analytical decision process. An intuitive decision is conducted based on how other people or other companies have acted in similar decision situations. When using an analytical decision process investment information is analysed through business models or with help by a consultant adviser (Öhlmér & Lönnstedt, 2004).

In small-scale businesses it is common that the decision maker uses an intuitive decision process (Öhlmér & Lönnstedt, 2004). The main advantage with the intuitive decision process is that it demands less external information and theoretical framework. Instead, the decision is made based on previous experiences and gut feeling of the decision maker. However, conducting a good intuitive decision requires considerably of the decision maker. He or she needs extensive experience or knowledge of similar situations.

There are several types of decisions to conduct within a company. One of these is whether or not to conduct investments. In order to evaluate different alternatives, the company conducts an investment appraisal (Lumby & Jones, 2003)

4.1.1 Investment appraisal

When a company decides to conduct an investment they must forsake other dividend payments, salary increases for the staff and alternative investments (Bergknut *et al.*, 1993). In order to motivate a company to invest, it should create a higher value than alternative uses of the money. Conducting a decision in line with the owners' interest is important. Therefore stakeholders should be involved in the decision making process at an early stage even if they are not taking an active role in the process (Vermeulen, 2008).

In order to make a good and balanced investment decision the company needs to be aware of every known consequence and outcome of different investment alternatives (Löfsten, 2002). However, analysing every possible alternative may be very time consuming. The decision-maker must therefore decide how much money and time they will commit to the decision process. Conducting a solid and good investment decision is often quite difficult, since it is often associated with a great deal of uncertainty and an investment often extends over a long period of time (Skärvad & Olsson, 2008). This is why a company should always conduct studies of different solutions before the final investment is completed (Zavrl, 2008). One way of evaluating and supporting investments, or financial decisions, is by using numerical calculations (Lee *et al.*, 1999). Calculations add objectivity and data to the decision process

and therefore make the process easier and more exact. However, the data should be relevant and correct in order to benefit the decision process.

Comparing investments alternatives may be feasible by using different calculation methods (Yard, 2001). The most commonly used calculation methods to evaluate an investment are the payback method, Internal Rate of Return (IRR), Net Present Value (NPV) and the annuity method (Kayali, 2006). These calculation methods are widely accepted in the economic literature. However, they may not be suitable for investments involving a great deal of risk.

An investment should always be conducted in line with the strategic goals of a company (Ljung & Högberg, 1999). The pros and cons with each investment alternative need to be weighed against the company's main goals. Another part of the investment decision process is to assess the risks involved (Grubbström, 2005). Different investment types offer different levels of risk. One type of investment may look good on paper, but in reality it may be associated with a great deal of risk. This is why planning the investments in a company is essential (*ibid*.).

4.1.1.1 The lifespan of an investment

In order to structure an investment appraisal one needs to decide a limit for how long the investment's duration will be. The lifespan can either be determined to the product's economic life or another fixed period of time that is suitable for the investor (Olve & Samuelson, 2008).

The economic life span is the time one should keep an investment in order to maximize the present value (Grubbström, 2005). In order to establish the economic life different calculations are required to evaluate how maintenance costs increases during the product's lifetime (Eliasson *et al.*, 2005). Due to higher maintenance costs it might be better to replace the product with a new one instead of repairing it after a certain period of time. Economic life span can also be shortened due to technological improvements that can outperform the older product (Grubbström, 2005; Olve & Samuelson, 2008). It is important not to confuse economic life with technological life span. Technological life represents the maximum lifetime one may keep a machine without experiencing any major drops in performance or reliability. Technological life is often much longer than the economic life.

4.1.1.2 Required rate of return

The required rate of return should state what yields the company demands on an investment (Yard, 2001). The rate should also consider factors such as risk, uncertainty, inflation, price changes and other investment possibilities. The rate of return can be described as a type of alternative cost. In order for an investment to be profitable it should at least match the yields available if using the money in other activities such as for example investments in the stock market (Brealey, 2014). It is very important to define the rate at a correct level, a rate determined too high may suggest that short term investment alternatives are exceedingly more profitable (Olve & Samuelson, 2008). A rate determined too low might on the other hand suggest that long-term investments are too profitable.

4.2 Net Present Value (NPV)

In order to calculate an investment's profitability companies use different types of discounting methods. One of the most accepted and widely used is Net Present Value (NPV). This method discounts all cash flows created by an investment during a pre-set timeline to the value of the present time, or before the investment is conducted (Grubbström, 2005). Given this method is

it possible to evaluate investment alternatives with different time spans. Companies normally support the NPV calculation with other types of calculation methods in order to obtain a more complex and precise investment evaluation process.

If NPV displays a positive result, the investment yields a positive payback compared to the initial investment costs (Lumby & Jones, 2003). When a NPV calculation results in zero, the investment reaches breakeven given the required rate of return. If the calculations display a negative result the investment does not yield sufficient cash flows to balance out the initial investment cost. The idea with NPV is to indicate how much future cash flows are worth in today's monetary values. If an investor make several NPV calculations on different investment alternatives, he or she should the investment option that yields the highest positive result (Brealey, 2014).

In NPV calculations the capital cost is determined based on how much risk the investment is associated with and also what returns the investors' demand of the investment (Brealey, 2003). A NPV calculation should consider inflation when determining the capital cost (Grubbström, 2005).

NPV is a good instrument to use in order to demonstrate to shareholders how their investment is most likely to turn out if they decide to invest in the company (Brealey, 2003). Investors' may then compare the NPV calculation with other investment alternatives.

4.3 Internal Rate of Return (IRR)

IRR is the interest rate that results in a NPV of zero, which may also be labelled the yield to maturity (Brealey, 2014). The internal rate of return is the rate where the market value is the same as the present value of the investment's future cash flows (Quiry & Vernimmen, 2011). IRR is normally used as a tool to roughly evaluate whether or not an investment is profitable. The IRR is solved by numerical simulations (Grubbström, 2005). The decision rule for IRR is uncomplicated; if the investment's IRR is greater than the required rate of return then the investment is profitable (Quiry & Vernimmen, 2011).

4.4 Annuity

Annuity is best described as a fixed sum that is paid or received regularly during a limited period of time (Brealey, 2014). The core principle of the annuity method is to distribute the investment's cash flows equally over the investments economic life – in so-called annuities (Andersson, 2008). An investment, evaluated through the annuity principle, meets the demands determined by the company if the annuities yield a positive number. If the company investigates multiple option facing similar preconditions, they should choose the investment that yields the highest annuity. In theory, the greater the annuity, the more profitable the investment should be (Skärvad & Olsson, 2008). The annuity method is also suitable to use for an investment that is just associated with capital costs (Olve & Samuelson, 2008). If the method is used to calculate the annual cost, the investment that yields the lowest result should be chosen.

The annuity method is often used to compare different investment options that have different economic lifetimes. For example, a new machine normally has a longer economic lifetime than a used one (Andersson, 2008). However, the used machine is less expensive and has a lower residual value. However, calculation alternatives that display large differences in their economic life bring a theoretical dilemma for the annuity method. Different alternatives that face different lifetimes are not directly comparable with each other. The company must

therefore implicitly make the assumption of conducting the same investments until their added lifetime match each other (*ibid*).

5 Method

According to Robson (2011) "enquiry in real world is very much the art of the possible". Mark-Herbert (2002) states, "It is a matter of making choices and being aware of the research conduct". The aim with this chapter is to outline different methods that are used when deciding data, literature, theory, machine categories and financial limitations.

5.1 Literature review

The section about the literature review attempts to show which studies have been conducted previously within the same research field. According to Robson (2011) is it important to do a literature review before taking on the subject for the new project. In this study the literature review is conducted to give a greater knowledge and understanding for leasing and the problematic with downtime and investments in small companies. The literature review is based on articles from academic journals. The first step is to search after studies relating to field machinery downtime and leasing. The literature review is conducted by using databases like Primo, Science Direct, ProQuest, Web of Science and Web of Knowledge. Other literature and thesis were also gathered trough LIBRIS, the national database of Swedish libraries. Data have also been collected from the SLU-library, Skogforsk database and Statistics Sweden's (SCB) database.

The results concerning investments in small companies and leasing revealed a lot of research concerning leasing factory equipment and investments in small companies in USA. The phrase machinery break down or downtime didn't give any useful material. After some research it is found that the sentence "mean time between failures" gave better results. By adding words like "logging" and "farm" gave some useful references.

When it comes to finding useful articles about economic lifetime is harder. This is an unexplored field and some reports where found conducted in USA but no one useful for this study. One useful study about economic life and information about forestry machinery was found and it is a study of the European and American forestry market.

After the initial research is conducted, the seemingly most relevant articles are examined more closely in order to discover their relevance within the field of research (Robson, 2011). Certain aspects were explored more deeply by using the same search engines as listed above. The research proceeded by starting with one word and then adding combinations of terms. It may be so that articles are missed or overlooked, since the research area for the study is wide and consisting of three different head topics. Only articles in English and Swedish are examined due to language limitations. Some articles in Finnish have been found but the knowledge has not been extracted due to the language barrier.

5.2 Scientific approach and choice of method

A research study may have a qualitative or quantitative research angle or a mix of both (Robson, 2011). The study is carried out with a quantitative methodological point of view. The quantitative parts represent analyses of the online questionnaire and mathematical modelling. The focus of the study is deductive, and the thesis is created by using well known theories and principles (Bryman, 2011). By combining these theories and principles the author attempts to obtain conclusions on how investments in new forestry machinery should be formed.

When choosing the path for the study, it is of great importance to construct you research questions wisely (Robson, 2011). This is a critical step of the project because it is the pitch of the research questions that defines and makes the study unique.

According to Robson, (2011) data collection is an important and crucial part of a real world research project. Data for the mathematical models are gathered from Skogforsk and the Swedish banks-sector.

To evaluate outcome of the breakdown hours per machine and year Monte Carlo Simulation could be used (Lien, 2003). This type of stochastic simulation is of good use when dealing with uncertainties and when there is a need for up scaling smaller sample sizes into larger and more normalized. The main goal of simulation is to calculate the effect that specific risk sources add to a project (*ibid.*). In order to obtain a reliable observation for possible outcomes in the probability assessment you need to have good and reliable data (Hardaker *et al.*, 2004). The most obvious choice in data collection is to collect historical data. In this case no historical data concerning breakdown hours per machine and year or meantime between failure data (MTBF) is to be found. The data collected in the survey is characterized by a high standard deviation and therefore not well suited for Monte Carlo Simulation. Instead, a linear equation is estimated to predict the expected breakdown time for a forestry machine of its operating life span.

5.3 Survey

The survey conducted for this study will be a complement to supply data for the investment calculations. The aim with the survey is to establish the link between breakdowns and the operating hours of a forestry machine. The company Netigate provides the survey tool.

5.3.1 Choice of survey-method

In this study an online questionnaire is chosen as survey method. This since it allows the researcher to reach a wide number of respondents (Ejlertsson, 2005). There are two main types of Internet questionnaires; website-based or e-mail-based (Robson, 2011). There exists a wide selection of online-survey alternatives, which allows the researcher to find a suitable solution for his or her study.

The main advantages with online-surveys are that they are cost efficient. There is no need for papers, mail-service, stamps et cetera (*ibid*). The collection of the data is instant and the collection period normally does not spread over more than 20 days. Online survey-programs normally give the administrator powerful analysing-tools that are far more easy to use than it would be with a paper-based survey.

The main disadvantages with online surveys are that some people do not have access to Internet (*ibid*). Because the survey is only sent to forestry entrepreneurs in Sweden, this is not a large problem. In Sweden close to 90 percent of the population have access to a computer with Internet (Findahl, 2013).

Online questionnaires need to be self-explaining because there is no interviewer to explain the questions to the respondents (Denscombe, 2009). The questionnaire within this study begins with an introduction explaining how the questions are answered correctly. The author is also keeping the questionnaire fairly short and simple, which reduces the risk of confusion among the respondents.

5.3.2 Selecting and Contacting Potential Participants

The population to which the survey is sent to is Swedish forestry entrepreneurs that are connected to the interest-organization for Swedish forestry entrepreneurs (SMF). The author chooses this population because most of the forestry entrepreneurs are members of this organization (Körner & Wahlgren, 2002). The population is spread out across the country and vary in company size and age. The number of entrepreneurs that have given their email-address to SMF is 530. In order to increase the possibility of obtaining a substantial number of answers the author chooses to send out questionnaires to the whole selected population. The participants will be contacted through email and will be asked to follow a web-link where the questionnaire is located.

5.3.3 Analysis of the Survey Data

Analysing the data is a crucial part of the data collection process. The data need to be processed and analysed in order to provide any useful facts for the study.

Emails are sent to all of the 530 respondents, none of them have an incorrect email address – so all of the 530 emails reach their respondents. Of these 530 respondents, 104 choose to take part in the survey. Nine contractors open and read the survey but choose not to participate. Of these nine, eight originates from the northern part of Sweden. However, the group is too small for the author to be able to draw any conclusions from. The overall response rate for the survey is 19.8 percent. The author has no further information concerning the part of the population that chooses not to participate in the study.

Most of the questions in the survey are designed as closed questions. The main advantage with a questionnaire consisting of closed questions is that they are easier to construct and analyse (Aldridge & Levine, 2001). Closed questions are constructed in a way so that the respondent can only choose one alternative. Open response questions are constructed in a way so that the respondent has no alternatives to choose from but may develop their own answers. In this study, the open response questions are used in such an order to connect several questions to a given respondent and his or her machinery. The answers from the open response questions are used to display unique data for each machine.

It is important that at an early stage decide what type of data that is need for the thesis and how it should be processed and analysed (Robson, 2011). A forest entrepreneur is often time-pressed and normally works operationally in the company (pers. med. Hembjer, 2014). After that Hembjer and his colleague Kinnefors at SMF have examined at the pilot survey. The author in collaboration with Hembjer and Kinnefors decided to shorten the number of question to a minimum. By doing so Hembjer and Kinnefors thought that the answer rate most likely would be higher since the survey would be less time consuming and easier to overlook.

When carrying out the analysis of the survey the author discovers that some questions, and especially one, are being misinterpreted. A question concerning the model year for a machine is in some cases recognized as if the question refers to what type of model and manufacturer the machine originates from. Another important aspect to note is that the answers to a question regarding which investment evaluation method that the respondents may be affected by the possibility that the contractors are unfamiliar with the technical terms and may be using them without knowing it.

5.3.4 Use of answers from questionnaire

The questionnaire used in this study is displayed in Appendix 1. All of the questions asked are used to confirm or reject results from earlier studies and to support the analysis in this thesis. The first three questions are asked in order to put the contractors in this study into context with earlier studies of forestry contractors. These questions are also asked to give the contractor a more personal feeling for the survey. The following questions are asked in order to receive answers regarding how the contractors finance their machinery investments and how they own their machinery. The results from these questions also relate to whether forestry entrepreneurs conduct intuitive or analytical decisions when making machinery investments. The final questions are asked in order to receive data to support the calculations of the economic life.

5.4 Investment solution calculations

The aim with this study is to compare machinery investments by bank loan or leasing for a harvester and a forwarder. In order to make this comparison by calculations the author must explore the most economically optimal time to own a machine before replacing it.

5.4.1 Weighted annual cost

The weighted annual cost is calculated for a forwarder and a harvester in order to determine the economic life of each machine and thereby also determine when it is most economically rational to replace the machinery. Determining the economic life requires the discounted values of all future costs depending on the age of the machinery (Constantinides, 1990). When calculating the weighted annual cost for a machine it is assumed that annual costs for machinery that deteriorate increase each year due to increased maintenance. It is also assumed that the machinery is entirely self-financed.

Equation 1 is used to calculate the weighted annual cost where *i* is a real interest rate of seven percent (www, Agriwise, 2014) and *n* is the age of the machine within a time span of 1 to 20 years. The equation takes into account the purchase price for the machine and annual costs.

$$Weighted\ annual\ cost = \left[A + \sum_{n=1}^{N} C_n\,(1+i)^{-(n-1}\right] * \left[\frac{i}{1-\frac{1}{(1+i)^n}}\right] \quad (1)$$

Where:

A = Purchase price of machine
C_n = Annual operating- and breakdown cost at year *n*
i = Cost of capital of operator
n = time period 1-20 years

The weighted annual cost is calculated for both the harvester and the forwarder. For both machines there are two different working shift strategies, single shift and double shift. The harvester calculations need to address one additional strategy choice, whether or not to replace the saw head. Replacing the saw head on a harvester is usually required around every 10 000 operating hour to a cost of 600 000 SEK (pers. com., Bredenfeldt, 2014).

C_n in Equation 1 is displaying the annual operating- and breakdown cost at year *n*. In order to determine the operating costs for each machine the average number of operating hours is required. Table 2 displays the average number of operating hours for both the harvester and

the forwarder, within both the single shift and the double shift strategies, as received from the respondents of the questionnaire. The operating cost per hour is given through literature and statistics (Lazarus & Selley, 2002; Brunberg, 2013) (www, SCB, 2014; www, Reflex, 2014). The operating cost includes cost of labour, cost of fuel and oil, and planed repair costs.

Table 2. Average operating hours for forestry machinery

	Harvester		Forwarder	
	Single shift	Double shift	Single shift	Double shift
Average operating hours per year	1 831	2 538	1 821	2 612

The breakdown cost per hour is given through literature (Nordström *et al.*, 2009). In order to determine the annual breakdown costs it is also necessary to determine the number of breakdown hours per year. Data concerning the number of breakdown hours per year is received from the contractors through the questionnaire. The author chooses to determine the relation between the given number of breakdown hours and the given number of operating hours for both a forwarder and a harvester. This relation is then used to gain the number of breakdown hours in year *n* through the accumulated number of operating hours during that same year. Another method of gaining the number of breakdown hours is to use the given data from the questionnaire and through logarithmic distribution and simulation enhance the data and thereby create a more statistically correct picture (Mattsson, 2010). This method demands that the mean value of breakdown hours is larger than the standard deviation (*ibid.*) and is not used in this study due to that the received data from contractors through the survey results in a mean value smaller than the standard deviation.

A in Equation 1 is regarding the purchase price of a forwarder and a harvester. Prices are collected from several vendors within the business, wishing to remain anonymous. The author gathers both retail and list prices from vendors and then uses average retail prices in order to create average machines for the analyses. Table 3 displays the two types of prices for comparison.

Table 3. Machine prices for forestry machines

	Harvester	Forwarder
List price	4 657 600 SEK	2 929 200 SEK
Retail price	4 042 400 SEK	2 539 100 SEK

5.4.2 Cost of instalment loan

The bank loan in this study is a standard straight payback loan. This means that each repayment of the loan is the same across the entire repayment period and that interest expenses decrease as the remaining amount to repay decreases.

Initiating a machinery bank loan requires a down payment of 20 percent of the purchase price and the cost of capital for a bank loan is STIBOR30 plus 3.33 percent, which at the time of this study equals 4.38 percent (pers. com., Hällöv, 2014). In Equation 2, *t* is the repayment period for the instalment loan. The repayment period is also the most economically optimal time to own a forwarder or a harvester before replacing it, which is calculated through Equation 1 in section 5.4.1. For a harvester, the repayment period may be 60, 72 or 84 months

depending on working shift strategies and further investments. The repayment period for a forwarder may be 60 or 84 months depending on working shift strategies.

$$Annual\ cost\ of\ instalment\ loan = \left[\frac{Z}{\left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]}\right] \quad (2)$$

Where:
Z = 80 percent of purchase price
r = cost of capital charged by the financial institute
t = optimal time for machinery replacement

5.4.3 Cost of leasing

Leasing is a type of annuity loan with advance payments where the down payment is 20 percent of the purchase price, the cost of capital is STIBOR30 plus 3.33 percent, which at the time of this study equals 4.38 percent, and the residual value of the machine is 10 percent of the purchase price when the leasing contract comes to an end (pers. com., Hällöv, 2014). The time frames for the leasing contract are the same as for the bank loan, *t* in Equation 3; 60, 72 or 84 months for a harvester and 60 or 84 months for a forwarder, depending on working shift strategies and further investments.

$$Annual\ cost\ of\ leasing = \left[\frac{Z - \frac{RV}{(1+r)^t}}{\left[\frac{1 - \frac{1}{(1+r)^t}}{r}\right]}\right] \quad (3)$$

Where:
Z = 80 percent of purchase price
RV = residual value, 10 percent of purchase price
r = cost of capital charged by the leasing firm
t = optimal time for machinery replacement

5.5 Validity and reliability

Pidd (2009) states that validation is an ideal to strive for and science should be dedicated to support the real world. The validity of the questionnaire refers to the fact that the questions cover the correct subject and essential and are measured correctly.

In order to obtain as reliable data as possible for the analyses the author contacted several bank and lending institution to get the loan and leasing calculations correct. With the economic life calculation is numerous machine vendors contacted to get right price data for the machinery.

The questionnaire questions have been designed and evaluated along with employees in the forestry contractor trade organisation. This is done to ensure to get the correct information and to receive a high answering rate as possible.

5.6 Ethical aspects

The participants in the survey are guaranteed their anonymity. This is a norm when conducting surveys (Robson, 2011). By guaranteeing the participant's anonymity they will hopefully answer more correct and truthful. The anonymity may increase the answer-rate. It is also of great importance to carefully thinking through how the questionnaire is constructed in order to obtain truthful and correct answers.

One of the ethical key points during a survey is to inform the respondents about what the purpose of the survey (*ibid.*) It is also important to inform the respondents how their answers will be handled and stored in the future (Grinyer, 2002). The author should also inform the respondents about who is conducting the study, why they were chosen for the study and how. All this should be communicated in a cover letter to the questionnaire along with information that participation in the study is totally voluntary but of great importance for the researcher.

Some contractors have chosen to skip two of the questions in the survey (Q13 and Q15) concerning detailed information about the machinery. The reason for this could be that the information asked for is far too detailed and/or revealing and therefore demands more time from the respondents.

Although information from already published material and statistics is of importance and relevance to this study data is obtained from not only the online questionnaire but also by contacting external experts and companies. Each of the persons that is contacted is given a short briefing about the study and how their expertize knowledge can help the project forward. Each of them are then provided with the choice to be anonymous or if the author may refer to them in the thesis. Every person that is referred to in the text receives a copy of the final version before the report is published to the public. This is done to avoid any misunderstandings.

Some of the machinery-vendors ask specifically to be anonymous in order to give the author correct and real sales prices for the machinery instead of list prices. This is explained by the fact that the industry is small and it is easy for other vendors to take advantage of competitors openly revealing sales prices. All data from the vendors are used to create an average price for an average forwarder and an average harvester, which enhances the anonymity possibilities.

6 Results

In this section the results are presented. There are three types of results; from the questionnaire, from the author's own calculations and from comparing bank loan and leasing.

This chapter consists of three subchapters: results from questionnaire, results from computing and bank loan vs. leasing. The chapter is constructed like a three-stage-rocket. Like seen in Figure 2 results from the questionnaire are combined with other collected data to create the foundation for the economic life evaluations. The results from the calculations regarding economic life suggest the optimal length of time to own a machine before replacing it. This information is used together with other collected data when constructing the evaluations for instalment loans and leasing.

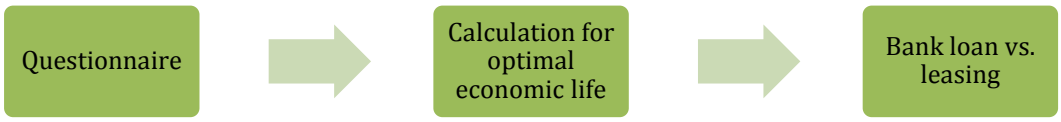

Figure 2. The three-stage-rocket describing how the results chapter is constructed.

6.1 Results from questionnaire

Of the 530 forest contractors, 104 completed the online questionnaire. This amounts to a response rate of 19.8 percent. This is a quite low response rate but compared with other questionnaires conducted in the same sector, then 19.8 percent is a modest and expected response rate. The low response rate increase the margin of errors which may affect the reliability of the study (Robson, 2011).

6.1.1 Introductory questions

The first three questions of the questionnaire present some fundamental information about the companies. This information is relevant from a demographic view and positions the responding companies within a context of each other and the sector.

The first question relate to what number of employees the companies have, including the owner. As can be seen in Figure 3 the majority of contractors have five or less employees, indicating rather small companies.

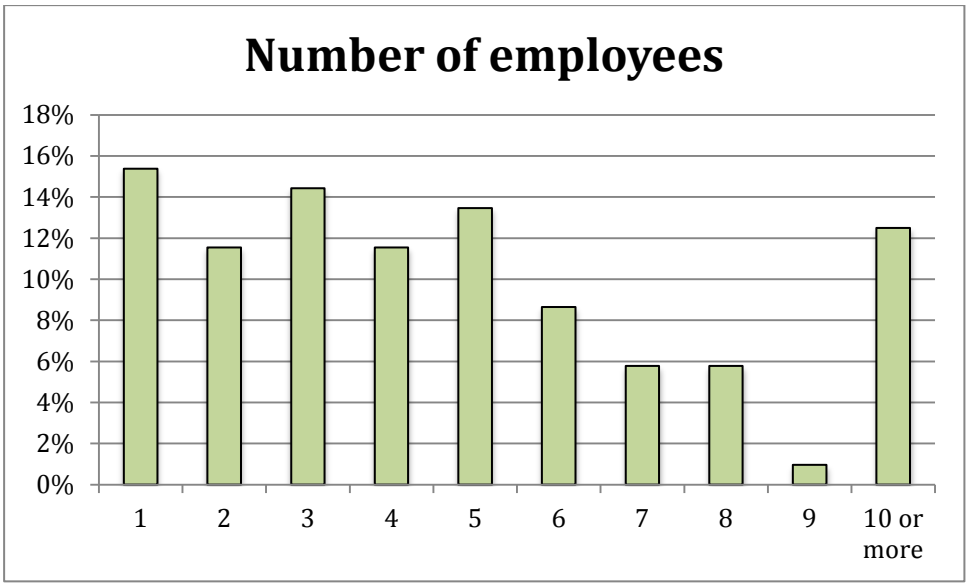

Figure 3. Question one - how many employees within the company?

The second question in the questionnaire relates to how many years the companies have been active within the forestry sector. As seen in Figure 4 a large group of companies have been active for 25 years or longer, indicating that the respondents have long experience within the business sector.

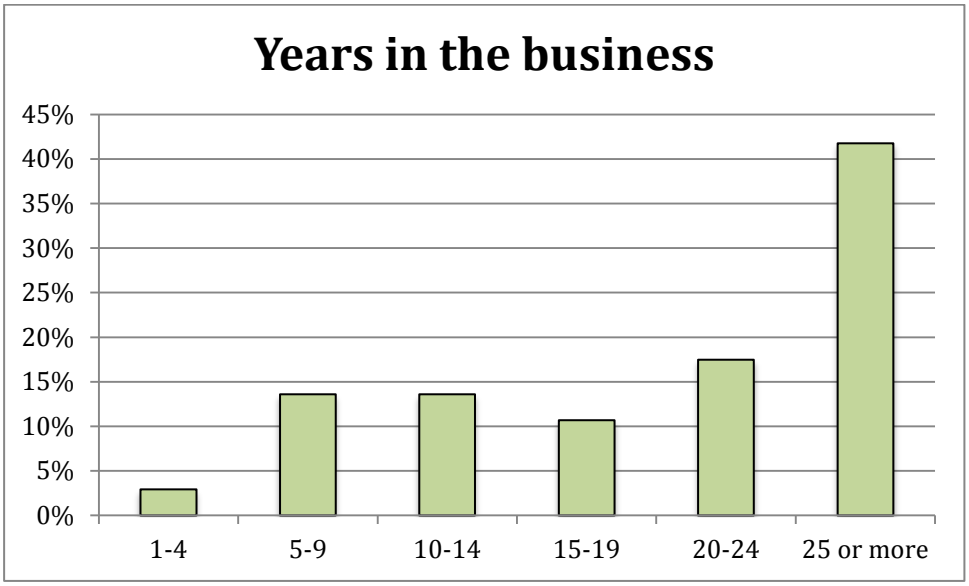

Figure 4. Question two - how any years within the business sector?

The third initial question relates how the respondents view their profitability. Figure 5 displays a perceived profitability that is low or mediocre. One of the respondents has answered that he or she has no perception of the company's profitability and quite few within the group is finding their profitability to be rather good or very good.

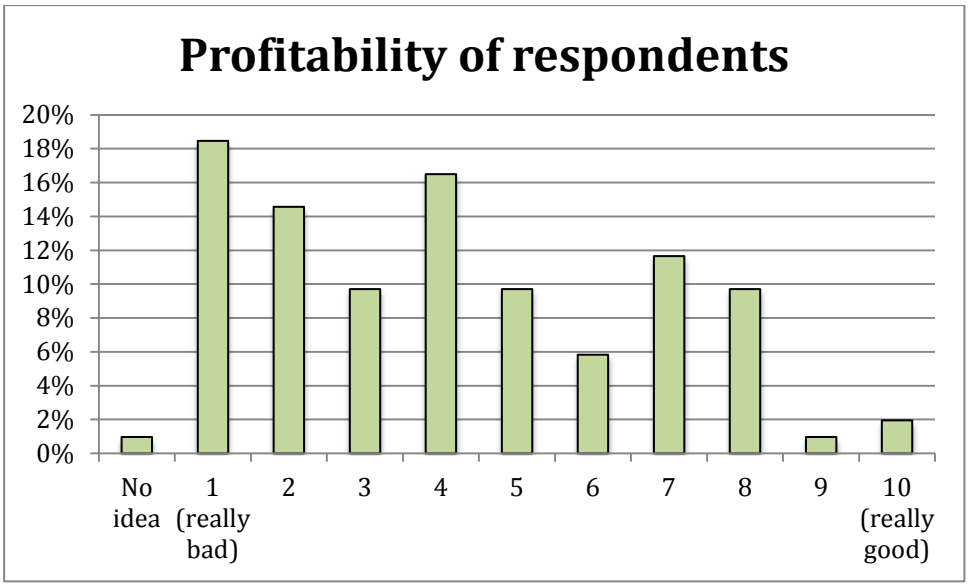

Figure 5. Question three - how is the profitability within the company?

All the answers to the initial questions combined indicate rather small companies, which have been in the business for quite a long time and the profitability seems to be rather low.

6.1.2 Investment evaluation and financing

Figure 6 displays what type of investment financing the contractor chooses to use when ordering a new forestry machine. As seen in Figure 6, instalment loan is overrepresented among the contractors. 74 percent use instalment loans compared to the second most use method, financial leasing that accounts to 18 percent use. Only 8 percent use cash payment and none use operational leasing.

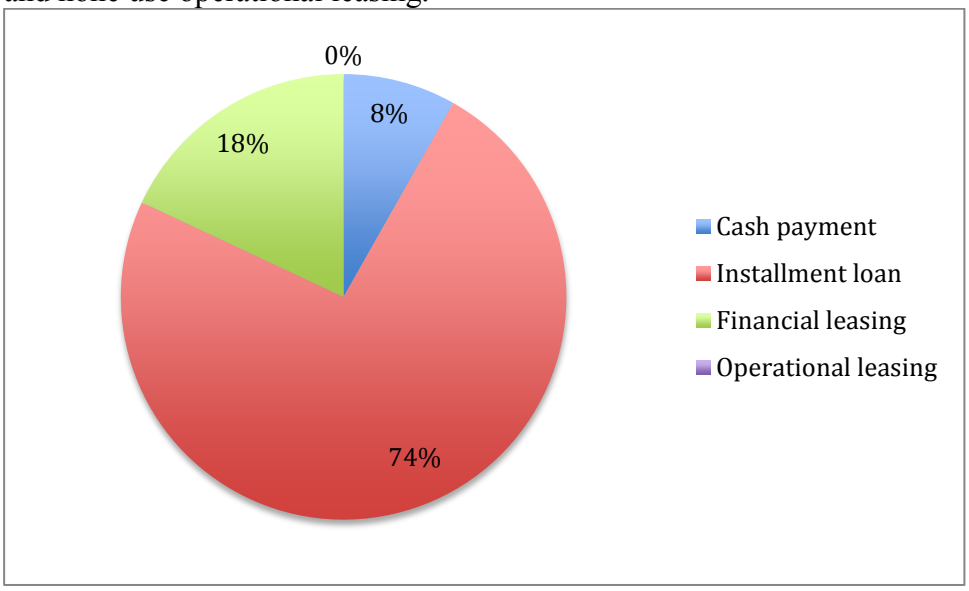

Figure 6. Investment financing alternatives used by the contractors when purchasing new machinery.

The contractors that answers that they do not use leasing as a financing method when acquiring a new machine are asked why they do not use leasing. The question is asked in order to examine if it is relevant to conduct a comparison between instalment loan and leasing. Out of 79 contractors that do not use leasing, 69 answered why. Table 5 is a selection of the answers that best summarizes all answers. A summary of the respondents' thoughts and

feelings regarding leasing displays that contractors believe that leasing is expensive, complicated and difficult to terminate if the financial situation for the company changes.

Table 4. Quotations from questionnaire

Q5. If you don't use leasing as a financial form, why?
"If you lease a machine, you do not have trust in your business sector"
"I want to own my machine"
"It is hard to get out of a leasing contract"
"I have good contact with my bank"
"To expensive"

Figure 7 displays that around 26 percent of the responding contractors have at some point of time conducted a gross capital formation, where the vendor values the contractor's old machine higher than the market price and thereby allows the contractor to redeem an existing bank loan and invest in new machinery (see section 2.2 for further information). The vast majority, of 67 percent, responds that they have never done such affairs. A small group of the responding contractors respond that they do not know whether or not such affairs have been conducted.

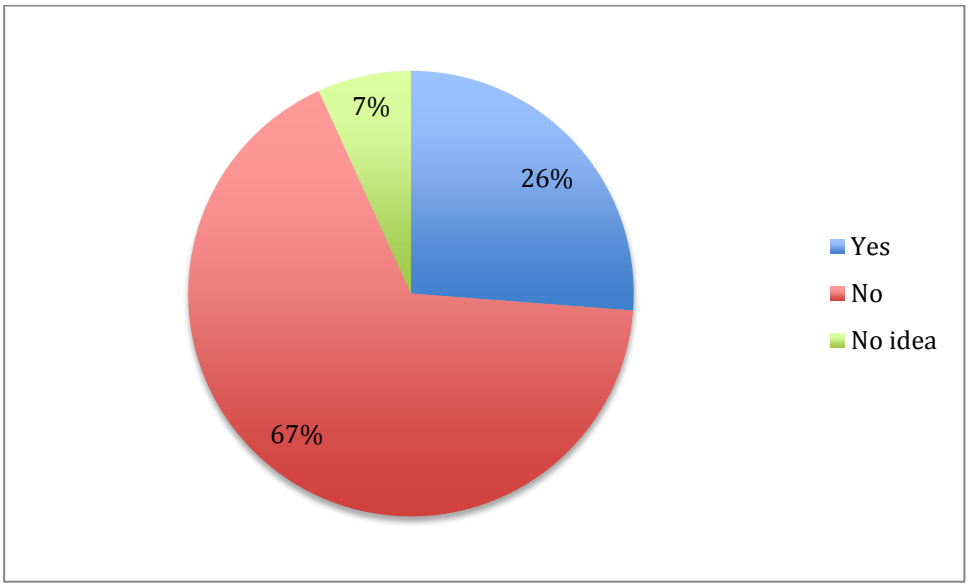

Figure 7. Percentage of contractors that have performed a gross capital formation.

Whether or not the responding contractors conduct investment evaluations before purchasing a new machine is presented in Figure 8. As can be seen, 55 percent of the contractors do carry out evaluations before investing. The contractors that respond that they do not conduct investment evaluations before purchasing machinery amount to 45 percent.

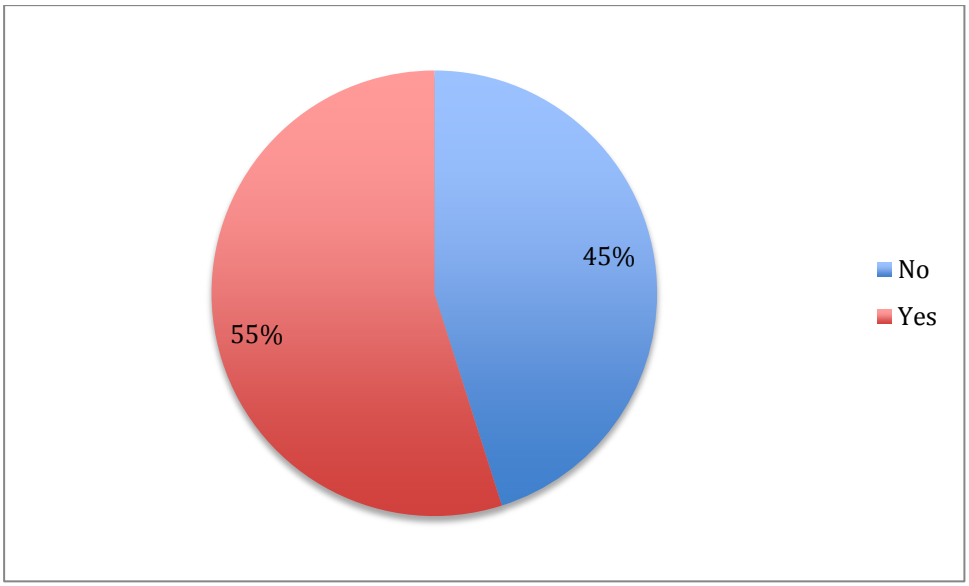

Figure 8. Whether or not a contractor conducts investment evaluations before purchasing a new machine

Figure 9 presents the different investment evaluation methods used by the contractors. The most frequently used method is the net present value, which amount to 25 percent of the respondents. A larger group use other types of investment evaluation approaches. It is important to note that the answers to this question may be affected by the possibility that contractors use evaluation methods without knowing the technical terms for that method.

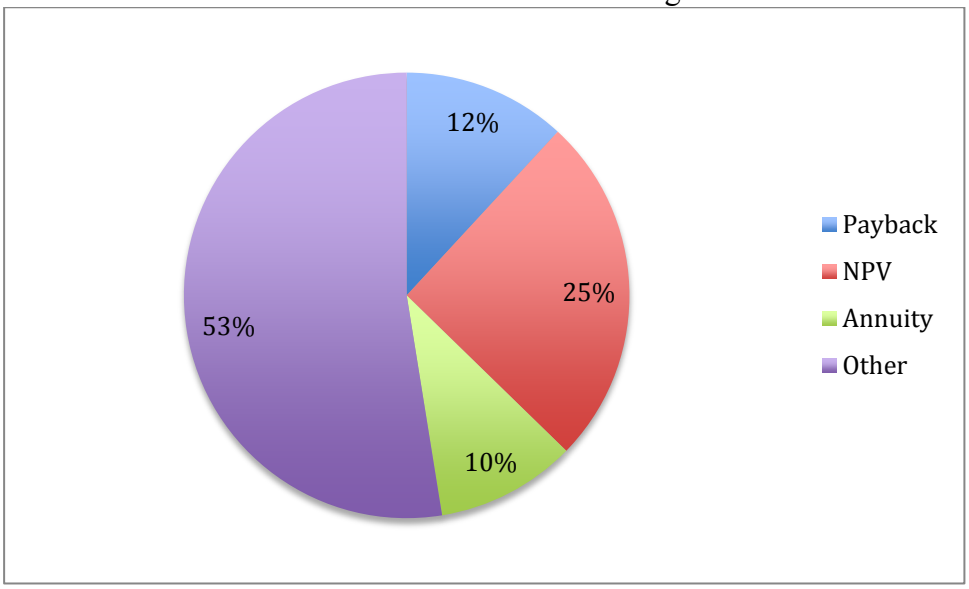

Figure 9. Different calculation methods used before a purchase.

As seen in Figure 10, the majority of the contractors (64 percent) are taking bids from several vendors before investing in a new forestry machine.

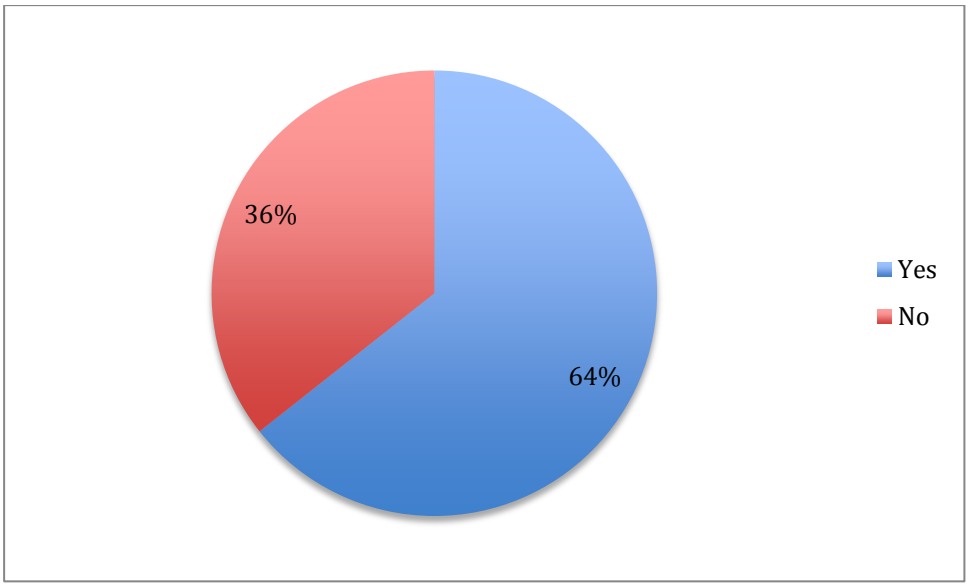

Figure 10. Whether or not contractors are taking bids from several vendors before investing.

Among the contractors that answered that they are taking bids from several vendors, the weighted importance of different factors regarding choice of vendor is presented in Figure 11. No factor separates largely from the others. The two factors that are slightly more important when choosing a vendor are, according to the contractors, service accessibility and quality and the availability of spare parts. The least important factors are the brand and price of the machinery.

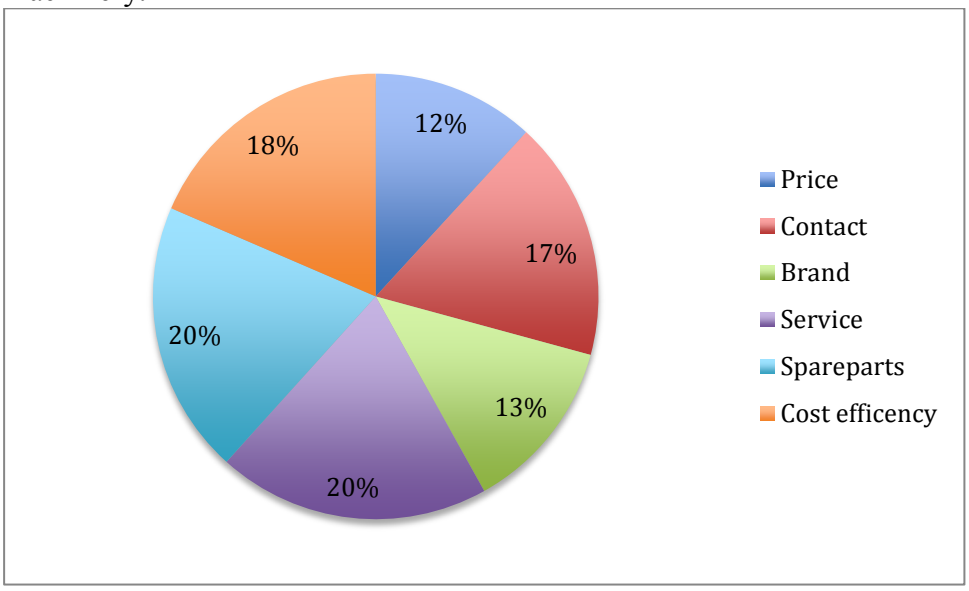

Figure 11. Which factors that are most important when choosing vendor.

6.1.3 Information regarding contractors' machinery

Figure 12 presents the number of years that the contractors choose to keep their machines before investing in new ones. There are slight differences between harvesters and forwarders. As can be noted in the figure, nearly half of all harvesters are replaced after 4.1 to 6 years. This should be compared to nearly 80 percent of all forwarders that are being replaced after 2.1 to 6 years. Only around nine percent of the harvesters and around four percent of the forwarders are kept more than eight years.

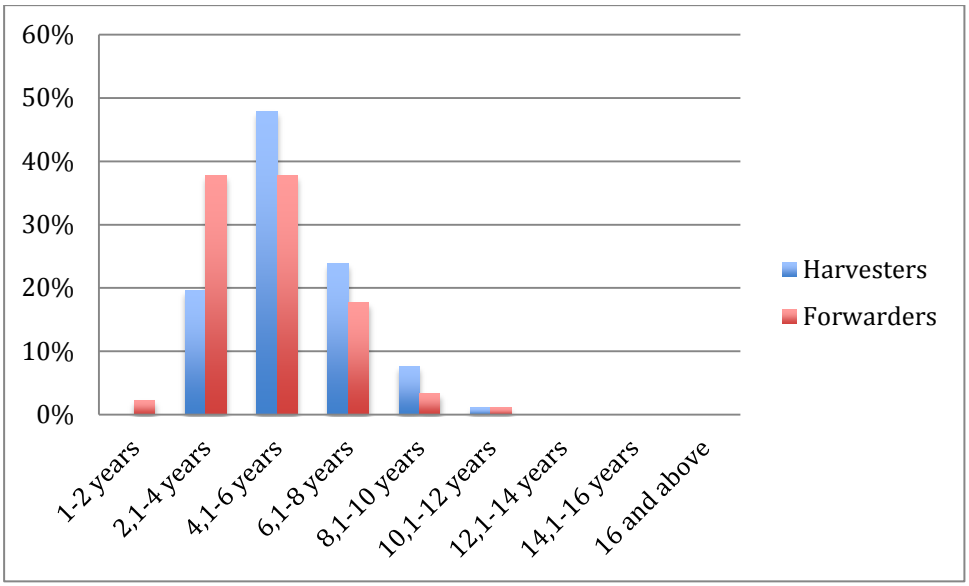

Figure 12. The amount of years the contractors keep their machines.

More than 50 percent of the contractors have a strategic plan for when to conduct future machinery investments, as displayed in Figure 13. Around 42 percent do not plan ahead in the same way and make investments when they are needed. A small group of five percent use their machines to the end of the technical lifespan before investing in a new one.

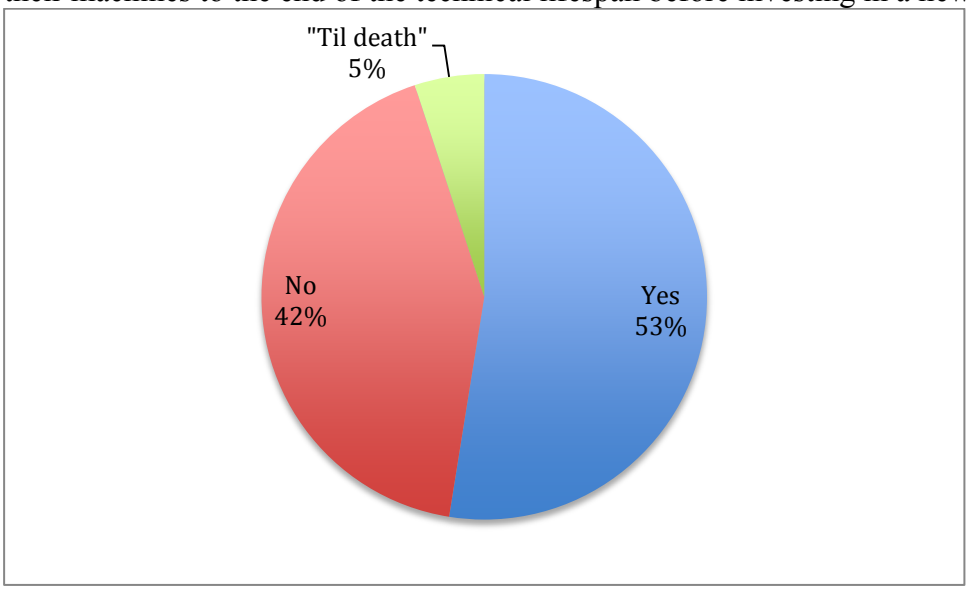

Figure 13. Whether a contractor plans future machine investments.

Figure 14 indicates that owning one harvester or one forwarder is most common among the responding contractors. This relates to the first question of the questionnaire regarding number of employees, which stated that most of the companies are rather small. Around 20 percent of the contractors own one of the machinery types. It is not common to own several machines of the same type, especially not three or more.

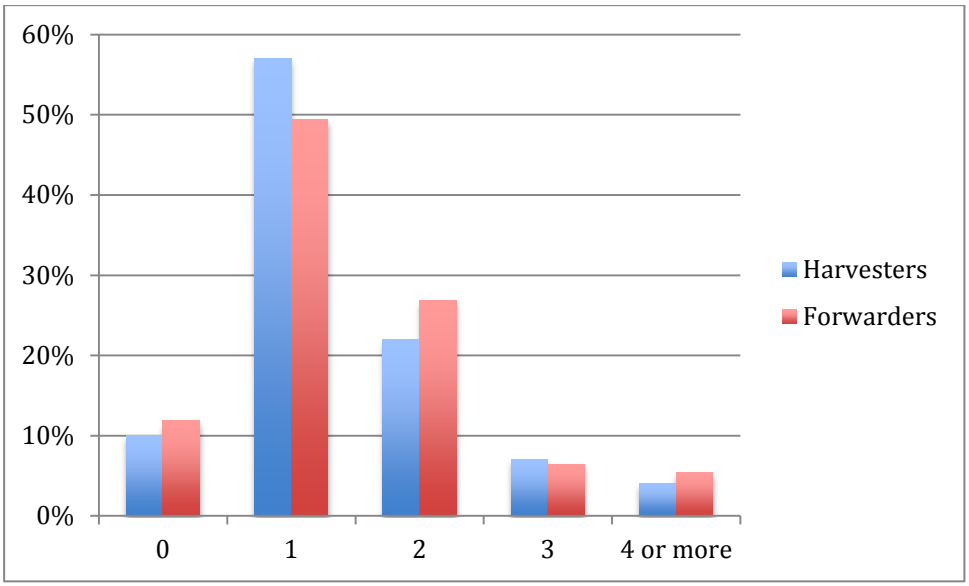

Figure 14. Owned number of machines per contractor.

Over 60 percent of the contractors that own harvesters operate their machines in double shifts rather than single shifts, implying that the machines operate during most of the day. According to Figure 15, the shift strategies for forwarders are more evenly spread. Here both alternatives account for around 50 percent each. This compared to harvesters where the difference between the strategies is more substantial.

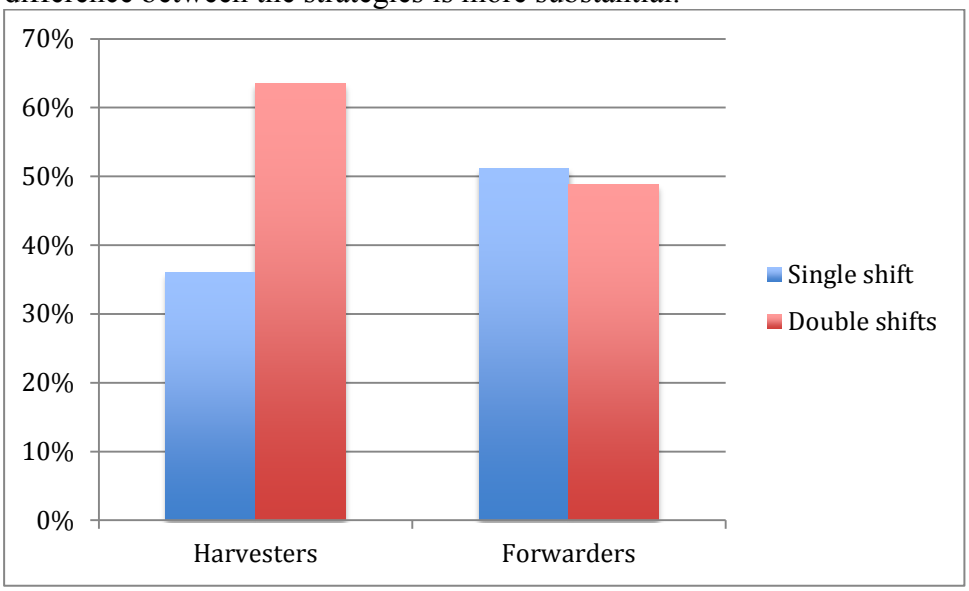

Figure 15. Shift strategy divided by machine type.

Unplanned downtime may cause problems. Figure 16 reveal that out of the responding contractors 52 percent try to make up for lost time by, for example, working the machines overtime. The remaining 48 percent of the contractors continue the work after unplanned downtime without extra attempts to make up for the lost time.

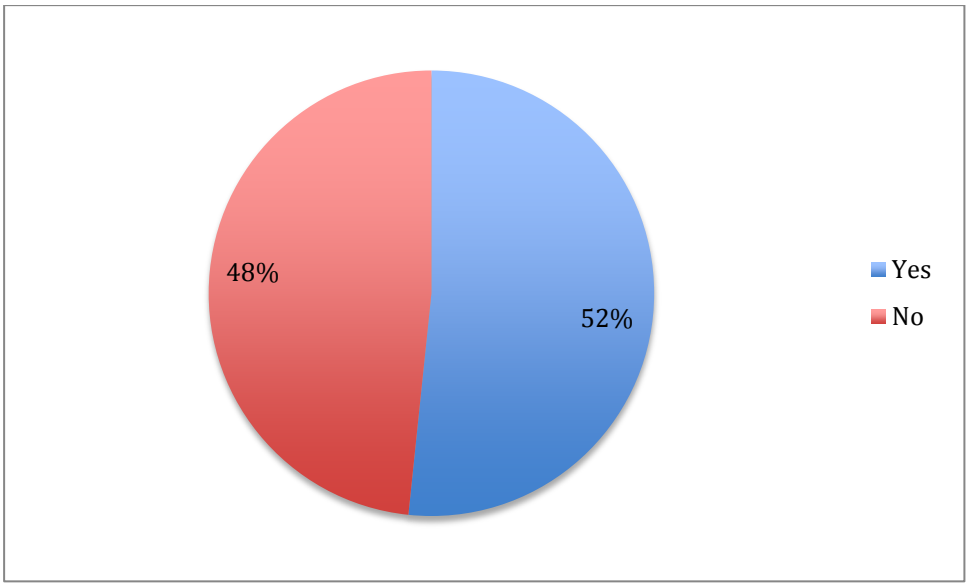

Figure 16. Whether the contractors make up for unplanned downtime.

The market value of a machine decreases over time. Figure 17 displays the percentage relation between the contractors' estimated market value of their harvesters and the initial purchase prices, depending on the age of the machine. As can be noticed, the values slowly decrease as the machines become older.

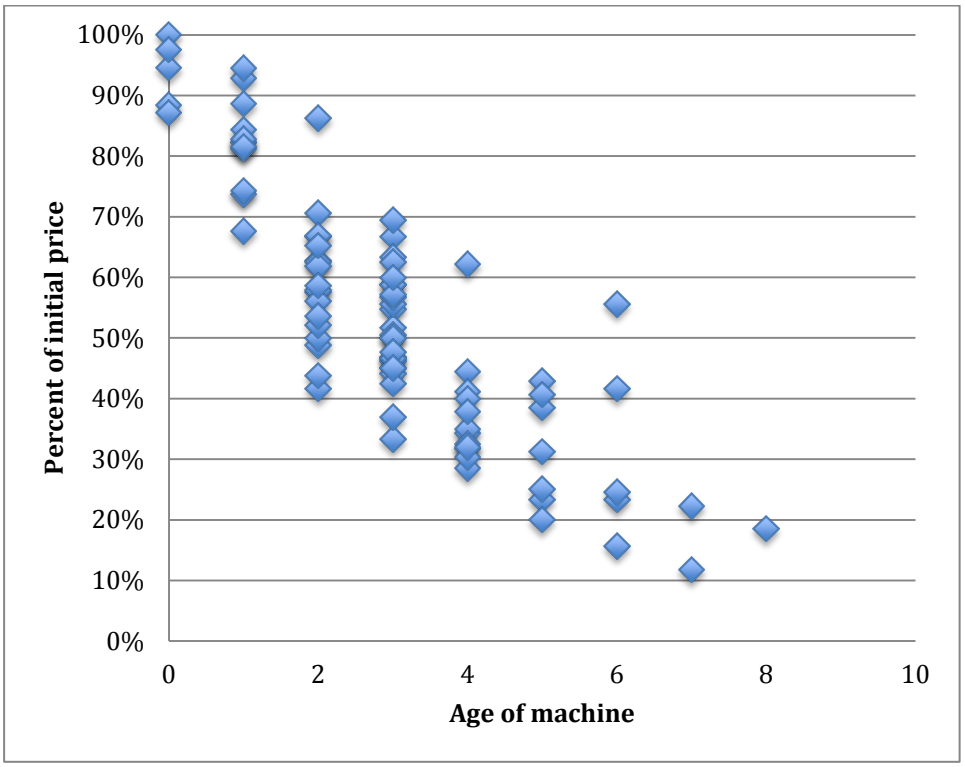

Figure 17. Market value of harvesters compared to purchase price estimated by responding contractors.

Figure 18 presents the same kind of percentage relations as Figure 17 but for forwarders. Noticeable is that the decrease in value is not as steep as for a harvester.

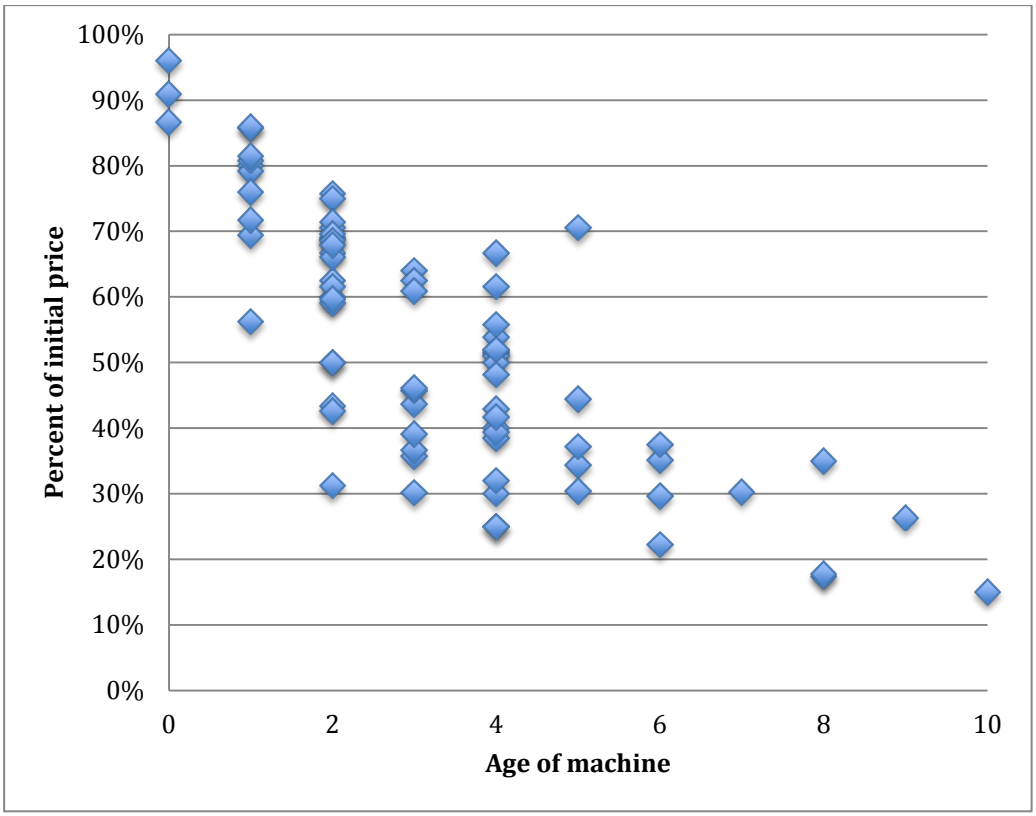

Figure 18. Market value of forwarders compared to purchase price estimated by responding contractors.

Figure 19 and Figure 20 are two scatter plot diagrams where each dot represents a respondent's machine. The contractors have responded how many hours their machines have been used within the company and how many downtime hours they had in 2013 for this specific machine. To get an insight into whether there is any connection between the machines overall usage and the number of downtime hours per year a simple regression line is calculated according to equation (4).

$$y = a + (b * x) \quad (4)$$

Where:
y = Downtime hours
a = A constant that specifies where the regression line crosses the y-axis
b = A constant that specifies the regression coefficient
x = Total operation hours.

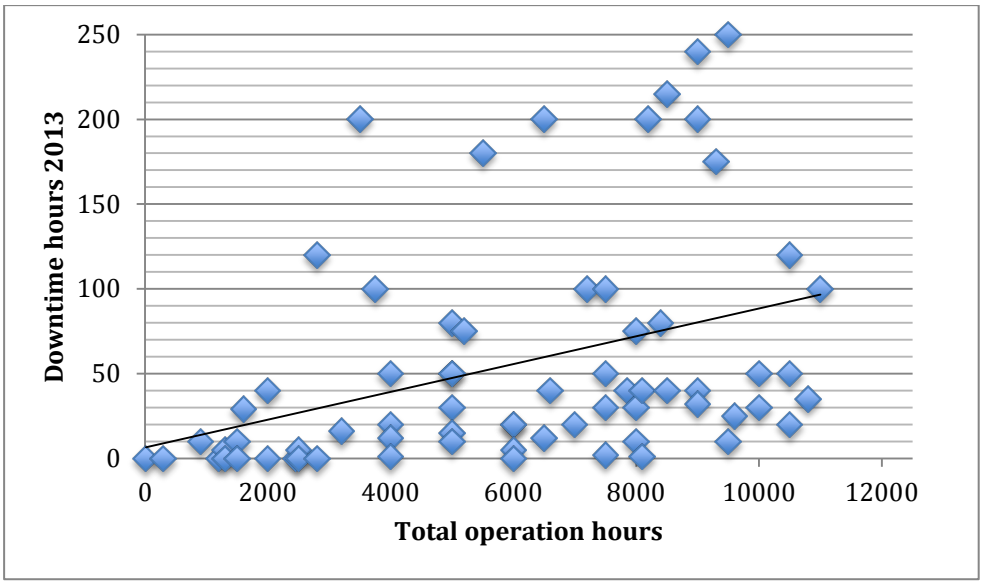

Figure 19. Downtime hours during year 2013 related to the total operation hours of harvesters.

The regression lines in both Figure 19 and Figure 20 indicates that there may be a connection between downtime and a machine's total usage. That is, it appears possible that the more hours a machine has been used the more downtime.

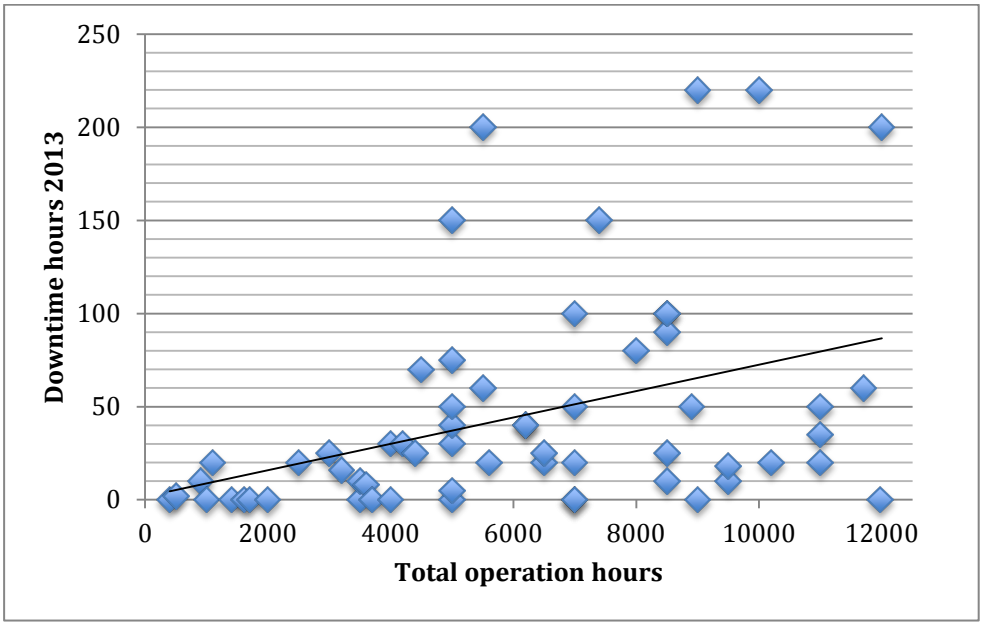

Figure 20. Downtime hours during year 2013 related to the total operation hours of forwarders.

6.2 Results from computing

In this section the results from the questionnaire combined whit other data are presented in different calculations. These results are later used for the leasing and bank loan calculations.

Using the calculation technique by Constantinides (1990) for the different strategies for each machine, results in the following section. The different strategy set-ups are, for a harvester, single shift or double shift and with or without changing saw head every 10 000 operating hours (pers. com., Bredenfeldt, 2014). For the forwarder the strategies are single shift or

double shift. Using the double shift strategy results in the machine being used more intensely during the year, around 40 percent more compared to the single shift strategy.

Figure 21 displays the average annual machinery costs for a harvester with a single shift strategy. As the figure suggests, the minimum average total cost, when changing saw head every 10 000 operating hours, occurs year five, when the machine has been used for around 9 100 operating hours. This indicates that it is more rational to invest in a new machine before it is time to change saw head.

For the strategy of not planning regular saw head replacements, the minimum cost occurs year seven, when the machine has been used for around 12 800 operating hours. This indicates that without planned regular saw head replacements the most economically rational time to invest in a new machine is extended by two years. As Figure 21 implies there is a wider span of years, both before and after the most economically rational time where the machine can be replaced, without causing a substantial increase in the average operating cost.

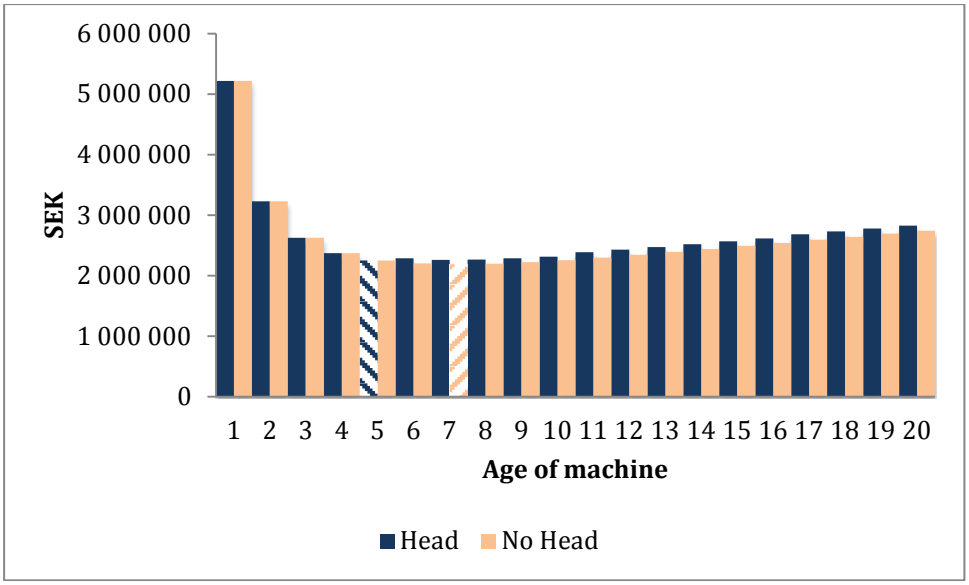

Figure 21. Average total machine cost for a harvester with a single shift strategy; with and without changing saw heads, for each year

The average total machinery cost for a forwarder is displayed in Figure 22. The most economically rational time for investing in a new machine occurs year seven, where the annual cost is at minimum and the machine has been used for around 12 700 operating hours. The figure also indicates a range of years where a replacement may occur although it is not the most economically rational alternative.

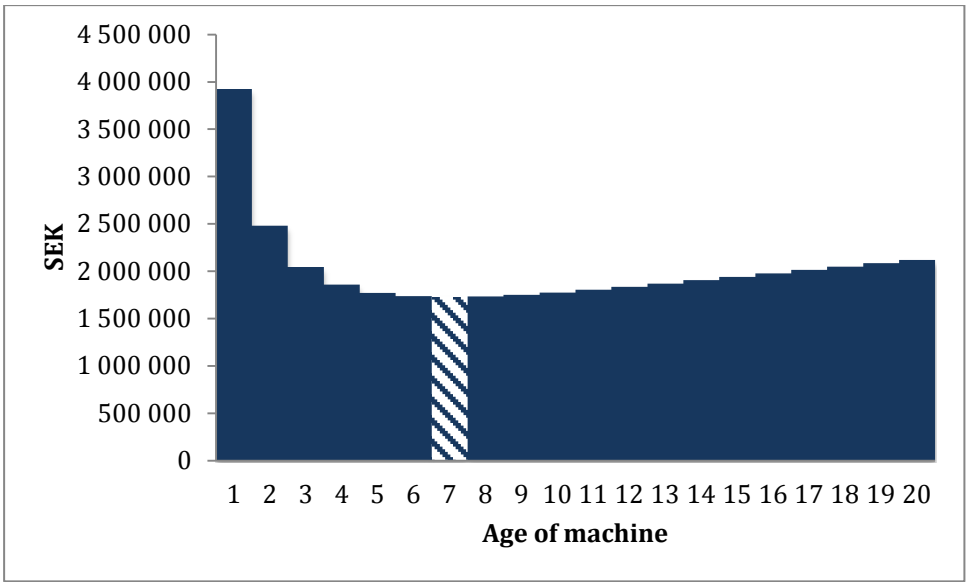

Figure 22. Average total machine cost for a forwarder, with a single shift strategy, for each year

Changing strategy to double shifting the machines results in slightly different results. Figure 23 displays the average total machinery cost for a harvester with a double shift strategy. As previous, there is the strategy of planned regular saw head replacements and the strategy of no planned replacements. Here, the most economically rational time to invest in new machinery occurs at year six when planning for saw head replacements and five years without planning for saw head replacements.

In this case, the machine has then been used for around 15 000 operating hours and around 12 600 operating hours respectively. This means that at around 15 000 operating hours a saw head replacement has already occurred after 10 000 operating hours, making it more economically rational to keep the machine longer compared to not planning regular replacements.

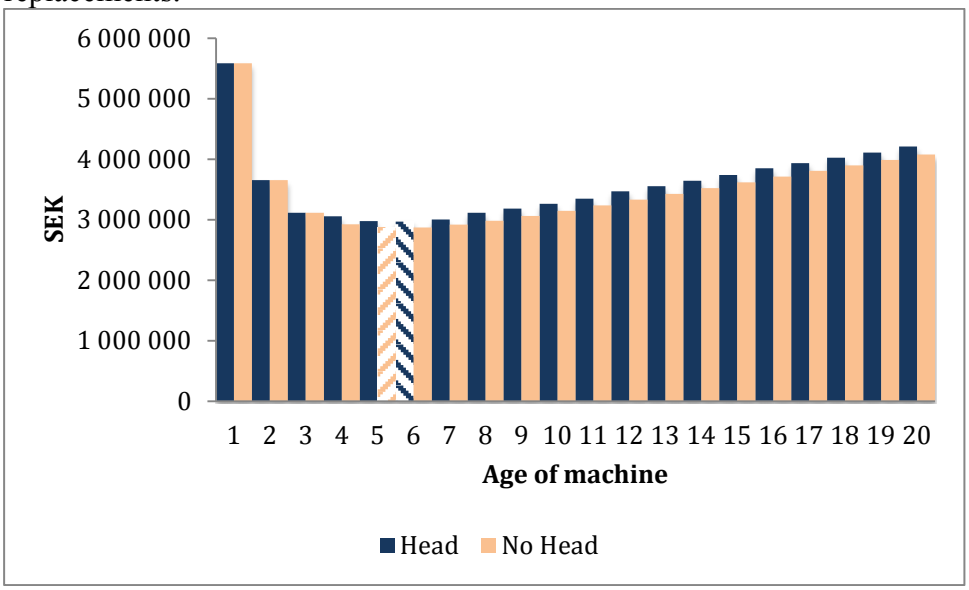

Figure 23. Average total machine cost for a harvester with a double shift strategy; with and without changing saw heads, for each year

Figure 24 displays the results for a forwarder and shows that the most economically rational time to invest in new machinery is at year five when the forwarder has been used around 13

000 operating hours. The most rational time occurs two years earlier compared to the case when the machine operates in single shifts.

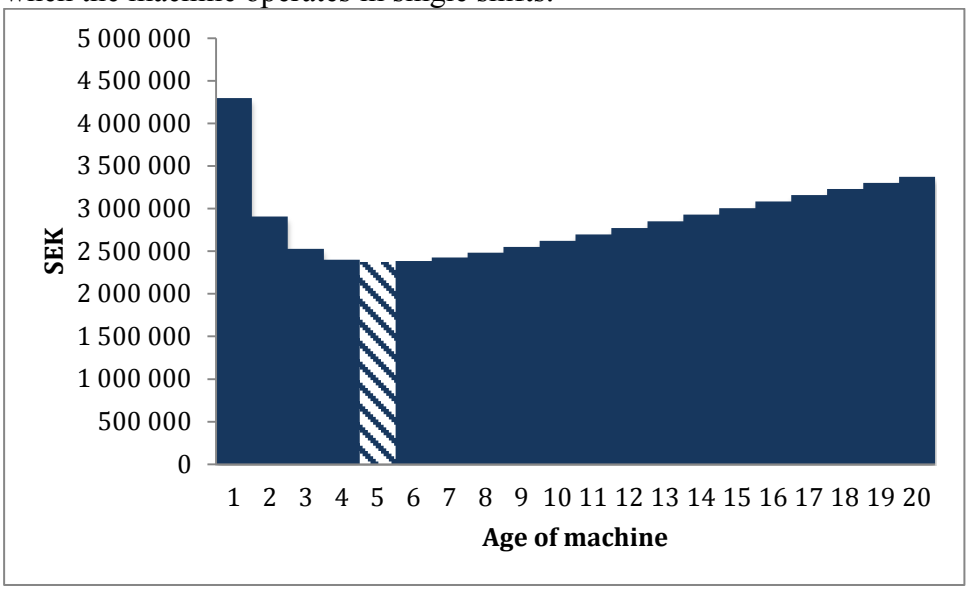

Figure 24. Average machine cost for a forwarder with a double shift strategy, for each year

The results obtained in this section is used to set the calculation time lines for comparing instalment loans and leasing contracts in the next section.

6.3 Leasing versus Bank loan

The comparison between the investment financing solutions leasing and bank loan, or instalment loan, can be seen in Figure 25 for a harvester and in Figure 26 for a forwarder. As displayed by Figure 25, instalment loan is the more inexpensive option for a harvester regardless the contract length. The average difference in cost between the two financing solutions is around 13 percent, but as the figure displays the difference appear to increase when the contract length is longer.

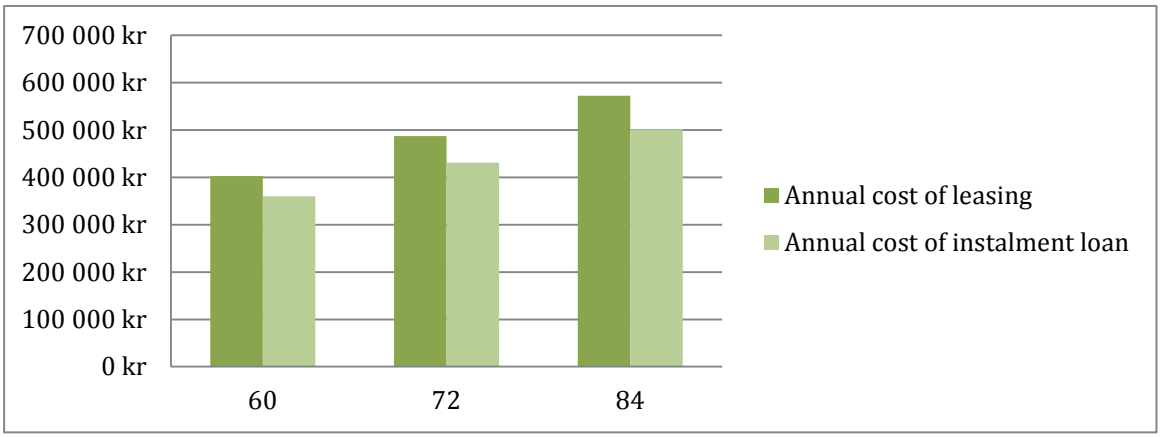

Figure 25 Annual cost of leasing and instalment loan for a harvester, over three contract lengths.

Comparing the financing solutions for a forwarder displays similar results as for a harvester. The bank loan appear to be the more inexpensive option, as can be seen in Figure 26, and the average difference in cost is around 13 percent. As the figure displays, the difference appear to increase when the contract length is longer.

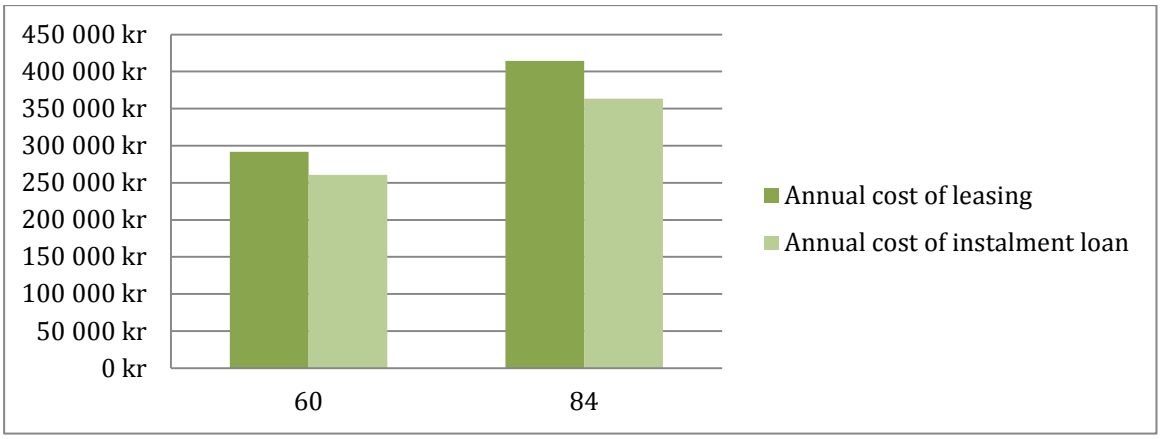

Figure 26 Annual cost of leasing and instalment loan for a forwarder, over two contract lengths.

7 Analytical discussion

This chapter presents an analytical discussion concerning the results of the study. The results are assessed against previous studies and the questionnaire results are considered against the calculations.

7.1 Machine usage and economic rationality

Most of the contractors have small businesses with one to five employees, including themselves, and own a few machines of the same type. At the same time, many of the contractors have been in the business for more than 25 years.

According to the analyses, contractors today use their harvesters and forwarders at an average of 2 300 operating hours per year. This is slightly higher than the 1 600 hours that Spinelli *et al.* (2011) report in their study but it is still within their time span of reported usage. For this study to display similar results concerning this area is interesting since the study by Spinelli *et al.* (2011) examines the Finnish, German and Italian conditions. It being so may imply some similarities between Swedish and other European condition.

The contractors seem to be keeping their harvesters for around four to six years, implying that they use the machines for around 8 000 to 12 000 operating hours before investing in new machinery. Forwarders are kept for two to six years, implying a use of around 4 000 to 12 000 operating hours. This is similar to what Spinelli *et al.* (2011) discovers in their study and their calculations. At the same time, they claim that the machines should be sold after eight years, which do not coincide with the observed behaviour of Swedish contractors. The results from this study indicate that the most rational time occurs between five and seven years, depending on machine type, usage and shifting strategy.

Swedish contractors seem to be replacing their machinery a bit too early; although some keep their machines a long time after its economic lifetime has passed and the annual costs are increasing rapidly. The investment patterns may be a residue from the eighties and nineties when the technological and ergonomic development was rapid (Nordfjell *et al.*, 2010). Therefore it was beneficial to replace machines often, especially harvesters. However, the rapid development has stagnated during the 21st century, creating a new situation for rationally replacing machines.

More than 50 percent of the contractors plan future machine investments, something that is important in order to make good decisions (Grubbström, 2005). 42 percent of the contractors seem to lack a strategy for future machinery investments and seem to work this out as the need for investments rises. This strategy in terms of owning a machine may work well if the contractor keeps an eye on when systems start to fail on the machine. Five percent of the contractors state that they keep the machine until it literally falls apart. This strategy may result in major breakdown and long productions stops as a result. Owning a machine for a longer period of time does on the other hand give a lower capital risk.

The numbers of breakdowns that forestry machines had in 2013 seem to increase with the number of total operating hours. This is similar to the results of the study conducted by Kováč *et al.* (2013) where the mean time between failures decreased with higher operating hours. Kováč *et al.* (2013) also state that it is of importance to have as few numbers of breakdowns per operation hours as possible. Although both Kováč *et al.* (2013) and this study indicates

that age and total usage of a machine affects the amount of breakdowns it is relevant to remember that breakdowns also vary due to external factors, for example terrain, the competence of the operator and the built-in quality.

This study yields similar results where breakdowns quickly become a major expense for the contractor. A greater part of the contractors state that they try to make up for lost working time due to breakdowns, something that they must pay extra for or work overtime. If the cost of labour and lost production time is eliminated then the breakdown hours do not affect the contractor more than a loss of leisure time.

7.2 Contractors' behaviour and investment solutions

According to the survey, 55 percent of the contractors conduct investment evaluations before investing in a new forestry machine. Zavrl (2008) argues that it is of great importance to assess an investment and find out ones alternatives before purchasing. A remarkable number of the contractors (45 percent) say that they do not make any calculations before purchasing a new machine. This coincides with a study by Norin (2010), which reveals that very few of the successful forestry contracting entrepreneurs in Sweden take the time and make the effort to evaluate an investment before making a decision. On the other hand, the study by Norin (2010) also reveals that the successful contractors have a good view of the economic performance, despite the lack of calculations.

Considering these results in the light of that the majority of the responding contractors feel that their profitability is below five on a scale of one to ten, where one is really bad and 10 is really good, one may wonder what impact machine investments have on the companies' total financial situation. As discussed earlier, some Swedish contractors may keep their machinery for a too long period of time before replacing it. The economic impact of this strategy might be relevant for the contractors to explore.

The most common way of financing an investment in a forestry machine is predominantly bank loans. Swedish contractors seem to find financial leasing expensive, complicated and almost as a symbol of distrust towards the business sector. Contractors seem to want to own their machines; a traditional and slightly conservative way of thinking that probably stems from the eighties (Hultåker, 2006). At the same time Khalil and Goitom (2009) concludes that leasing is an easy and convenient investment solution for small sized companies that do not have a lot of liquid assets. The conclusions by Wahlström (2012) show that the state of the company's liquidity has the largest impact on how a company chooses to finance investments. If a company is characterized by a poor liquidity it tends to use leasing more often as a way of financing. However, this does not seem to be supported by the results in this study since although the contractors claim low profitability they still seem to prefer using bank loans as financing alternative. It is a noticeable picture, when considering that Soirinsuo and Mäkinen (2009) argue that borrowing money to purchase new machinery, in a weak financial situation, is not a good way to improve the economic conditions of the company.

A comparison of bank loans with leasing in this study that borrowing is a less expensive way of financing an investment. These results are supported by Dumler *et al.* (2010) who argue that bank loans are more advantageous than leasing. One of the main disadvantages with leasing is that it demands long and steady contracts. Bank-loans make it possible to sell a machine and pay off the loan in a situation where the financial situation of the company decreases rapidly. By leasing, a contractor is more restricted and faces a long commitment.

These restrictions are one reason for why Swedish contractors choose not to use leasing. This might be due to the uncertainty within the forestry sector.

A disadvantage with bank loans is that if a purchase is conducted in an incorrect way through a gross capital formation and the company finds itself in a situation where the machine must be sold, then the company may end up with a bank loan that far exceeds the actual value of the machine. If this happens, it might not be possible to completely pay off the bank loan and the company may end up with debts. Although 67 percent of the responding contractors claim to never have conducted a gross capital formation, there are still 33 percent that have or may have conducted these incorrect dealings of trade. It is quite alarming if companies that already have low profitability and a weak financial situation would put themselves in situations like these. These situations quite probably may result in worsening conditions not only for the contractors but also for the entire business sector.

8 Concluding comments

The aim of this thesis is to explore and calculate the most cost effective investment solution of an investment in forestry machinery within a forestry contracting business by comparing the investment financing alternatives leasing and instalment loan. To reach the aim, three questions are asked and in this section these questions are answered based on the results and the analytical discussion.

According to the investment analyses and based on the results from the questionnaire, the most economically rational time to invest in a new forestry machine is between five and seven years depending on strategy. For harvesters it also depends on whether or not the contractor plans regular saw head replacements every 10 000 operating hours or not.

Swedish forestry contractors face low profitability and are more commonly using bank loans as a financing solution when investing in a new forestry machine. This behaviour is in contrast to the findings in previous studies claiming that bank loans are a bad option when in a weak financial situation and that leasing is a good alternative for small businesses when facing low liquidity. At the same time, the contractors find leasing expensive. This results with findings in previous studies where bank loans are more advantageous. The restrictions concerning a leasing contract are also among several of the key factors why Swedish contractors choose not to use leasing. One reason for contractors not wanting to be restricted for a long period of time might be the uncertainty concerning developments in the forestry sector.

The study shows that bank loan is the most cost efficient investment solution, although the difference between the two options is marginal. The longer investment horizon the better the bank loan seems to be. However, previous discussions suggest that there are advantages and disadvantages with both bank loans and leasing. The most economically rational alternative to choose very much depends on the preconditions.

The results and conclusions in this study are not completely suited for generalizations, since forestry-contracting entrepreneurs are not homogenous and each has their own preconditions. Nevertheless, the results in this study give an indication of whether bank loan or leasing is the most cost effective investment financing method. A company, before each individual investment decision, should always conduct a comparison between investment solutions.

Future research

The forestry sector and contracting entrepreneurs especially are under quite a lot of pressure. Considering possible future political objectives, further research concerning profitability, success factors and cost effectiveness within the sector is needed. Along with this issue on important question is to examine why list prices and retail prices vary as much as they do. Another interesting study to conduct is to examine the underlying reasons behind gross capital formations and how the sector may suppress the further developments of this kind of business deals. Finally, a relevant study to conduct within a Swedish context is to do a long-term analysis on how operating hours affect the meantime between failures.

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Personal messages

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Appendix 1: Questionnaire

Hello!
My name is Oskar Eliasson and I'm writing my thesis at SLU in Uppsala. I grew up on a forest farm in eastern Småland and I have spent my childhood with great interest in the development of the forestry contracting industry. This interest is something that I have taken with me during my studies and now I focus my essay on how forestry contractors can affect their profitability through optimal investment patterns.

In consultation with SMF Skogsentreprenörerna I conduct a survey in order to collect operating information and to identify how machine investments are made.
It would be very helpful if you could take your time to answer the survey. The survey takes approximately 10-15 minutes to complete.

Some questions will be about the operational details of the machine, such as operating hours and downtime. If you do not have detailed information at hand, please make estimations. Should you need to cancel or pause a survey, you're welcome to continue at a later time.

The questionnaire is available on the below link:
href='https://www.netigate.se/a/s.aspx?s=162694X¤user¤X¤pass¤'>https://www.netigate.se/a/s.aspx?s=162694X¤user¤X¤pass¤

Questions and possible answers:
Most of the questions in this survey consist of questions with possible answers, either scrollbar options or so-called cross-questions. Questions about the machines, however, are open text boxes in order to provide a good flexibility for you to fill in the various machine configurations.

It may be that you think some questions are hard to answer. You may have no exact data on what I'm asking about. If you do have an opinion or estimation, please give these. Your opinion is important!

Anonymity:
I use a survey company Netigate, which is a European leader in providing web-based survey tools. This guarantees that your answers are handled with the greatest security. No reader of the completed thesis will be able to see your individual responses.

When all questionnaires are received through Netigate all data will be processed and compiled into various reports. These reports are designed to provide an overall picture of the contracting business. No company will be hung out.

The survey is on going from 2014-05-16 to 2014-05-31.

Questions?
If you have questions about the survey, please feel free to contact me via any of the following means of contact:

Thank you for taking the time to complete this survey!

You will be asked to fill in 16 questions regarding your company and the machines. The survey is expected to take around 10 to 15 minutes to complete depending on how many machines you have.

I want to emphasize that all who participate in this survey will be completely anonymous.

1. How many employees do you have in your business (yourself included)?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 or more

2. For how many years have you been in the business?

- ☐ 1-4
- ☐ 5-9
- ☐ 10-14
- ☐ 15-19
- ☐ 20-24
- ☐ 25 years or more

3. How do you feel that your overall profitability has been the past year?

No idea	1 (really bad)	2	3	4	5	6	7	8	9	10 (really good)
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

4. Which form of financing do you use for your forestry machines?

* Financial leasing = A clean financial agreement, the lessee leases the machine and arrange services and repairs from third part.

**Operating leasing = This type of agreement might include value-added services such as service and maintenance.

☐ Cash

☐ Bank loan

☐ Financial leasing

☐ Operational leasing

Other form of financing: _____

5. If you do not use leasing as a financing alternetive, what is you biggest reason against?

Just answer this question if you do not use leasing.

_____

_____

_____

_____

_____

6. Have you ever had to make a capital gross formation when buying a new machine?

* In a gross capital formation the machine vendor pays extra for the the trade-in machine. This is done to avoid a capital gain loss due to that the contractor is carrying too high a value for the machine in their records. The same amount is then added to the new machine, which means that the issued loan may be higher than the actual value of the new machine.

☐ Yes

☐ No

☐ I do not know

7. Do you do extensive calculations before purchasing a new machine?

☐ Yes

☐ No

If you answered yes, what type of calculation method do you conduct?

☐ Payback method

☐ Net present value method (NPV)

☐ Annuity method

☐ Other calculation method

8. Do you take bids from several vendors before investing in a new machine?

☐ Yes

☐ No

If you do, what is the most important factors when you finally choose vendor?

	Low importance 1	2	3	4	Great importance 5
Cheapest alternative	☐	☐	☐	☐	☐
Good contacts with vendor	☐	☐	☐	☐	☐
Good service & repair.	☐	☐	☐	☐	☐
Access to spare parts	☐	☐	☐	☐	☐
Brand	☐	☐	☐	☐	☐
Operation economy	☐	☐	☐	☐	☐

9. Machine service and repairs.

Down below you are asked to fill in what of the following work you do yourself and what work you hire from a third part.

	In-house	Third part
Normal service (oil change etc)	☐	☐
Bigger service (complicated and advanced exchange parts)	☐	☐
Small repairs (minor welding and hydraulic repairing)	☐	☐
Bigger repairs (changing bigger and complicated parts)	☐	☐

10. For how many years do you own a machine before changing it?

	1-2	2,1-4	4,1-6	6,1-8	8,1-10	10,1-12	12,1-14	14,1-16	16 years or more
Forwarder	☐	☐	☐	☐	☐	☐	☐	☐	☐
Harvester	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. Do you have a plan for when to replace your machines?

☐ Yes

☐ No

☐ I own the machine to the bitter end

12. Questions about harvesters

How many harvesters do you own?

☐ 1

☐ 2

☐ 3

☐ 4 or more

How many shifts do the harvesters operate on?

☐ 1

☐ 2

13. Questions about harvesters part 2

Down below I ask you to fill in details for each individual harvester. If you, for example have two harvesters, you fill in the details for two harvesters. If you do not own any harvester, leave this question blank. If you do not have any exact information, estimates are enough.

Harvester 1

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the harvester have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

Harvester 2

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the harvester have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

Harvester 3

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the harvester have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

14. Questions about forwarders

How many forwarders do you own?

☐ 1

☐ 2

☐ 3

☐ 4 or more

How many shifts do the forwarders operate on?

☐ 1

☐ 2

15. Questions about forwarders part 2

Down below I ask you to fill in details for each individual forwarder. If you, for example have two forwarders, you fill in the details for two forwarders. If you do not own any forwarder, leave this question blank. If you do not have any exact information, estimates are enough.

Forwarder 1

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the forwarder have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

Forwarder 2

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the forwarder have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

Forwarder 3

Model year _____

Purchase price (without VAT). _____

Estimated sells price today. _____

Total operation hours? _____

How many unplanned downtime hours did the forwarder have in year 2013? _____

If you do not know the number of breakdown hours, please write number of times the machine have had breakdowns. _____

16. If you do get a large number of unplanned breakdown hours, do you try to make up for these lost hours?

☐ Yes

☐ No

17. Do you have any additional information that you think I should know about?

_____
_____
_____
_____
_____

Thank you for your time!

Best regards
Oskar Eliasson