



Wageningen University & Research Centre
Management Studies Group

Report

An analysis of knowledge protection methods in Agriculture

Cherish your knowledge

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Preface

This thesis is the last part of my MSc program Management, Economics and Consumer Studies with as specialization Management studies which I conducted at the Wageningen University. During my study I was always fascinated by Small and Medium sized firms (SMEs) and as son of entrepreneurial parents and maybe future entrepreneur, I wanted to focus my thesis on a topic that has to do with entrepreneurship. During the first appointment with my 1st supervisor Dr. V. Blok I became interested in the field of knowledge spill overs and how SMEs strengthen themselves against the negative effects of knowledge spill overs.

During my research I received a lot of help, good feedback and constructive critics, thanks to this I have been able to finish my MSc, in the current form. I would like to pay a special word of thanks to my supervisors Dr. V. Blok and Dr. C. Kolympiris for their time, patience and feedback during the process. I have learned a lot, not only about the topic but also about doing scientific research and what are possible pitfalls; and also make sure I stayed focussed and determined during the process.

I would also like to thank all firms that have cooperated during my research, to take the time to answer my questions or to fill in the questionnaire. Without their input and answers I could not have done this research and the results that are presented in this report. I would also like to thank Dr. H. Dons and Mr. M. Van Galen for their feedback on my proposal and questionnaire.

Furthermore I want to thank everybody that helped me during the process of the research and the writing of this report. Many thanks.

Hendrik Albada

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Executive summary

Predicting economic growth has been a very popular research topic in economics over the last decades. Many researches tried to develop models that could explain economic growth, however many models could not explain long-term economic growth. Only technological change i.e. innovations could explain economic growth, which doesn't mean that all innovations lead to economic growth. Economic growth of course has all kind of benefits like more jobs, more welfare etc. but innovations do not happen continuously, innovations are combination of knowledge; and start when certain knowledge meet other certain knowledge at a certain time.

However from a firm's perspective firms have incentives to protect their knowledge. Because firms that invest money in the innovating process also wants to profit from the innovations; because innovations can cause a competitive advantage. The problem is when knowledge spills unintended over to competitors who then also can profit from the investments made by the innovator. This is the reason why firms make efforts to protect their knowledge from spill over to competitors and from losing a competitive advantage. SMEs are firms with less than 250 employees are generally seen as the engine of the economy coming with lots of innovations. Due to their small size they need to focus on niche markets and innovate in order to distinguish themselves from large firms who have economies of scale advantages, so on price it is difficult to compete for SMEs.

There are various knowledge protection mechanisms available and they can be roughly divided into two categories namely formal and informal. The formal category exist of patents, copyrights, trademarks, contracts, design registration and breeder rights. These protection mechanisms have the advantage that they offer legal protection and as disadvantage that information needs to be disclosed. For informal protection mechanisms no information needs to be written down however it has no legal protection so when a competitor copies the innovation there is no protection by law. The choice depends highly on what the firm prefers. From the formal protection mechanisms patents are most widely used however in the last few years literature shows that there seems to be a shift to more informal protection mechanisms. This has various reasons but the most important one according to literature is that it is too costly. The use of informal protection mechanisms is rising. However it needs to be said that both can be used as complements.

The Dutch agro related sector has been seen as very innovative. Many innovations has come to the market in the last decade. However no research has been done so far on which knowledge protection mechanisms agro related SMEs are using. During this research 17 face-to-face interviews (15 dairy related firms, 2 plant breeding firms) were conducted and 9 more firms filled in a questionnaire about knowledge protection. Without any exemption all firms indicated that innovating was crucial for their firm. Due to geographical distances between competitors almost no firms experienced the effect of employees leaving the firm for a competitor and in some cases an employee started his own firm, mostly not in the same sector as his previous employer due to high start-up costs. All firms also stated that they are experiencing lots of competition. It was no surprise that all firms tried in some way to protect their knowledge. As expected from the formal protection mechanisms patents were most important. However as in line with the scientific literature agro related SMEs

preferred informal protection mechanisms. The reasons for this was in line with literature the cost are too high, especially when patents are violated, even if the firms is correct the cost for advocates and court can turn out to high for firms to enforce their patents. Firms value secrecy especially in the development phase very important because then nothing can be put on paper. Lead time is valued very good in cases when the competition needs some time before it can imitate the innovations, for example it takes a competitor a year to copy an innovation. During this year the firms can already build up such an advantage and keep improving the product. HRM is valued very good, and according to the interviewees underestimated, because a lot of knowledge is embedded in employees. This is why firms value their (R&D) employees as very important and want to remain them at the firm. Most innovations can be written down on paper however it was stated multiple times that future innovations and ideas come often from so-called knowledge workers. So there can be concluded that there is a trend towards informal protection mechanisms, also due to the more dynamic characteristics of informal protection mechanisms. However the choice depends highly on the sector and the firms preferences.

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1 Introduction

1.1 Problem indication

Predicting economic growth is a very popular economic research topic (de Faria & Sofka, 2010) (Delerue & Lejeune, 2010) of the last decades. Economic growth is defined as the increasing capacity of the economy to satisfy the wants of goods and services of the members of society (Mankiw & Taylor, 2008). However the economy doesn't grow by itself, according to the Solow model (Solow, 1957) the economic state can be influenced by changing production factors like capital and labour. The Solow model was developed by the economist Robert Solow, he tried to improve the existing models with his adjustments like adding capital and labour factors to the model. However these factors could not explain continuously long-term economic growth. Long-term economic growth is caused by innovations/technological growth (Mankiw & Taylor, 2008) (Keizer, et al., 2002) (Commissariaat voor Buitenlandse Investerings, 2001). Multiple theories exist who try to explain this phenomenon (Lee & Lan, 2011) (Delmar & Wennberg, 2010) (Vernon Henderson, 2007). One of the most well-known theories is the growth theory of Romer (Romer, 1986).

As already has been stated in the previous paragraph are innovations the basis for long-term economic growth. However this doesn't mean that all innovations lead to economic growth. Innovations are defined as followed:

Innovation is "a process that begins with an idea, proceeds with the development of an invention, and results in the introduction of a new product, process of service to the marketplace" (Edwards & Gordon, 1984).

However innovations do not just arise from the horizon. Innovations are a combination of knowledge. Knowledge itself will not lead to innovations however when knowledge meets at a certain point at a certain time a combination of different knowledge could lead to a new product innovation or process innovation (Amara, et al., 2008). As the name description already states, knowledge plays a crucial role in today's economy. "Knowledge means the ability to make information from data and to transform it into useful and meaningful information" (uit Beijerse, 2000).

The problem of knowledge is that once you capture it, it is very difficult to protect because knowledge has the tendency to spill out (de Faria & Sofka, 2010) (Oxford University Press & Turnbull, 2010) (Delerue & Lejeune, 2010). These are the so-called knowledge spillovers. When a knowledge spillover occurs unique knowledge goes from a certain firm/individual to another firm/individual (Eeckhout & Jovanovic, 2002). Global economic growth is caused by knowledge transfers/spillovers (de Faria & Sofka, 2010), these knowledge transfers cause innovations. Innovations are the result of combined knowledge which leads to new products/services (Amara, et al., 2008) (Blomqvist, et al., 2005). The production factor knowledge is becoming increasingly important in the economy of today (Delmar & Wennberg, 2010) (Arundel, 2001). This "new" economy is the so-called knowledge intensive economy (Muller & Zenker, 2001); according to the Oxford Dictionary this means "an economy in which growth is dependent on the quantity, quality, and accessibility of the information available, rather than the means of production".

As can be seen in the previous paragraph it is quite obvious that the economy is benefiting from knowledge spillovers. Several studies have proven the positive effect of knowledge spillovers on the economy (Hall & Scobie, 2006). As in line with the growth models of Romer, which state that knowledge accumulation and spillovers are the basis for economic growth (Acs, et al., 2009) (Romer, 1986). With growth models economists try to explain economic growth and it has been proven that innovations can cause long-term economic growth. This is why knowledge spillovers have been an important economic research topic in the last decades. Most research has due to this been done by economists.

Except for the positive effect on the economy, innovations and knowledge are also important on firm level. The main reasons for firms to innovate are to create new knowledge in order to develop new products/processes in the hope to gain a competitive advantage (Delerue & Lejeune, 2010). However this requires a lot of investments in knowledge, when firms innovate they want their investments at least to be earned back, this is called appropriation (Leiponen & Byman, 2009) (van Dijk, 2000). When a firm is not able to protect its valuable assets (knowledge and innovations) properly, competitors are able to imitate the firms (de Faria & Sofka, 2010). Knowledge and innovations are valuable assets to a firm in order to achieve a competitive advantage (Hurmelinna-Laukkanen, 2009) (Johnson, et al., 2009) (Haahti, et al., 2005) (Grant, 1996). Literature has also shown a positive correlation between firm performance and innovative efforts (Thornhill, 2006) (Keizer, et al., 2002). Innovative efforts of firms are frequently undertaken in the so-called R&D department. R&D stands for Research & Development and is responsible for new innovations or improving existing products, R&D is defined by the Frascati Manual as followed:

“Comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications”
(Guellec & van Pottelsberghe de la Potterie, 2001)

There are multiple mechanisms or methods which firms can use to protect their knowledge/innovations (Amara, et al., 2008).

There are roughly two types of protection mechanisms the first type of mechanisms that can be used are the mechanisms with legal protection. In literature these types of mechanisms are called formal, legal, IP, codified and direct. Besides the different typology there are no differences. For this research it has been chosen to use the typology which is used by De Faria & Sofka (2010) and Hall, et al. (2012). Formal protection mechanisms consist of patents, trademarks, contracts, design registration and copyrights (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Delerue & Lejeune, 2010) (Amara, et al., 2008). The legal protection of the formal protection mechanisms can prohibit other firms from imitating an innovation of a certain firm or let other firms pay for this type of protection (Jaffe, 1989) (Jaffe, 1986). The most used formal protection mechanisms is patents. According to Arundel & Steinmueller 2007 there is a huge amount of patents online; “in 1997 in Europe this number was around 850.000 patents and in the USA it was several millions”. The patenting behaviour shows large differences between countries (EUROSTAT, 2008).

“Informal protection mechanisms do not carry any legal protection and in case of innovations they can be unravelled by methods as reverse engineering” (Arundel & Steinmueller, 1998)

(Arundel, 2001). Informal protection methods include secrecy, lead time and HRM. For example HRM can be an important factor to increase loyalty of workers and to keep them motivated (Dahlggaard & Dahlggaard, 2003) (Simmonds & Pedersen, 2006); and has been largely ignored in research, however a few recent studies have stressed the importance of HRM (Gallié & Legros, 2012). Lead time can be beneficial in case of for example first mover advantages etc. (de Faria & Sofka, 2010) and means the time in between a firm comes with an innovation and the time the “competitor” needs to immitate this. This is also beneficial in fast moving markets where technological innovations follow each other rapidly and patents are too costly or take too much time, this is also the case with secrecy (Arundel, 2001) (Levin, et al., 1987).

The knowledge protection/sharing dilemma related to innovations are known to all firms, even though it is generally more notable for Small- and Medium sized Enterprises (SMEs) (Olander, et al., 2009). Because there are many different types of innovations it becomes even harder for SMEs to protect their knowledge. For small firms innovating (large R&D projects) may be harder because due to the size- and/or lack of resources, so much research is focused on large companies (Olander, et al., 2009). SMEs are more or less in a split when we think of innovating and combining knowledge. On the one hand they need to combine knowledge with other firms to innovate because they lack resources to carry out their own R&D projects but on the other hand they also need to protect their knowledge from spilling over to competitors (Olander, et al., 2009). So SMEs can benefit a lot from knowledge protection mechanisms.

1.1.1 Problem statement

In a knowledge intensive economy there are a lot of knowledge spillovers. In this type of an economy firms are likely to make more efforts into knowledge protection, because knowledge can make them achieve a competitive advantage. As a country the Netherlands are very knowledge intensive. This is stated by the numbers of the so-called KIA-coalition, the Netherlands is on the 7th position of the world (van Calmhout, 2012). In the Netherlands the agribusiness is perceived as a very knowledge intense business.

Innovations are very important for the Dutch agro complex (van Galen & Verstegen, 2008; Atkins, 1998). The Dutch agro complex is also perceived as one of the best organised in the world, with high levels of food safety and knowledge intensity. This is illustrated by the fact that the Dutch Agro food and Horticultural sector are achieving one of the highest application numbers for patents, only Japan, USA and Germany apply for more patents (Ministerie van E, L & I, 2011). Firms need to innovate in order to improve efficiency and be able to gain a competitive advantage. The Dutch agro complex consists of primary firms (dairy, arable farming, horticulture etc.) and direct relations of these firms like, suppliers, customers (processing firms), traders, transporters, financing firms and insurance companies. Together all these firms account for 9% of the total added value in the Dutch economy (van Leeuwen, et al., 2008). A more detailed overview is stated below in Table 1-1:

Table 1-1 Gross added value Dutch Agro complex (van Leeuwen, et al., 2010)

| Gross added value (factor costs) of the Dutch Agrocomplex | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------|-------|--------------------------------------------------|-------|-------|
| Sector | Agrocomplex total (a) | | | Agrocomplex, domestic agricultural raw materials | | |
| | 1995 | 2003 | 2008 | 1995 | 2003 | 2008 |
| <i>Agriculture- and horticulture</i> | 9.4% | 9.5% | 9.3% | 8.4% | 7.5% | 6.8% |
| Arable farming | | | | 0.9% | 0.9% | 0.8% |
| Horticulture | | | | 3.6% | 4.8% | 4.3% |
| Livestock | | | | 3.9% | 1.8% | 1.7% |
| <i>Processing industry</i> | 8.6% | 10.9% | 13.5% | 3.0% | 4.0% | 4.6% |
| <i>Supplying industry</i> | 8.8% | 12.4% | 15.6% | 6.4% | 8.7% | 10.6% |
| <i>Agrocomplex</i> | 32.3% | 41.4% | 50.5% | 20.2% | 23.0% | 25.4% |
| % of National Income | 12.0% | 9.7% | 9.6% | 7.5% | 5.4% | 4.8% |
| (a) Total agrocomplex including, agricultural services, forestry, gardening and the foreign agricultural rawmaterials based foodindustry (including cacao, beverage and tabbaco) | | | | | | |

Currently there are 70.309 (CBS, 2012) primary firms who are part of the Dutch agro complex, the number is decreasing for multiple years already, however the firms that continue their business are expanding. As an example the Dairy farms can be used, since 2000 the total number of Dairy farmers decreased by more than 10.000 however the number of cows stayed more or less the same (LEI, 2012), this means that the remaining farmers increase their herd size. The number of entrepreneurs however is increasing the last few years in the agricultural business as can be seen in Table 1-2. From 2009 till 2010 there was a growth of 17% in the number of entrepreneurs in the agriculture and fishery. The main cause for this is, that since 2010 every farm also needs to be registered at the Dutch Chamber of Commerce. Another cause is the fact that the growing farms have a higher need of other firms to help them with their work like breeding associations, financial services etc...

Table 1-2 Number of entrepreneurs in the Netherlands (Kamer van Koophandel, 2010)

| Number of entrepreneurs | | | | |
|-------------------------|--|----------------|----------------|-------------|
| Sector | | 1-1-2009 | 1-1-2010 | 2008-2009 % |
| Agriculture and Fishery | | 57900 | 67800 | 17% |
| Industry | | 73600 | 74500 | 1% |
| Construction | | 150200 | 143400 | -5% |
| Wholesale | | 104900 | 115900 | 10% |
| Retail | | 168200 | 177700 | 6% |
| Hospitality | | 72200 | 54300 | -25% |
| Transport | | 56200 | 51400 | -9% |
| Finance | | 33300 | 36000 | 8% |
| Consulting | | 174300 | 220800 | 27% |
| Facility Service | | 125200 | 154700 | 24% |
| Personel Service | | 133800 | 171100 | 28% |
| General services | | 69200 | 115200 | 66% |
| Total | | 1219000 | 1382800 | 13% |

In an innovative sector as the agro complex, innovation and knowledge are crucial factors in a way to improve performances and increase efficiency. The importance of knowledge protection as stated in the previous paragraph is also important for the agro complex.

As far as the literature study has reached so far, no literature has been found about the current state of the negative externalities of knowledge spillovers for SMEs in the (Dutch) agro complex. So far the little research that has been done has focused on the positive externalities of knowledge spillovers from an economy point of view (Hall & Scobie, 2006). But from a firm side of view there is a little known in scientific literature.

1.1.2 Practical and theoretical implication

Practical implication

By assessing the awareness of Dutch agro sector related companies of the negative knowledge spillovers and their actual practices to protect themselves against the negative effects of knowledge spillovers at firm level, the conclusions of this research could lead to a better protection against these spillovers.

So agro sector related firms can benefit from this research:

- Better awareness of the negative effects of knowledge spillovers
- Better awareness of the possible protection methods
- Better use of knowledge protection methods and so less suffering from the negative externalities of knowledge spillovers.

And by the use of this research agro (dairy related) sector can improve their awareness of this phenomenon and will be able to select the best informal methods to protect themselves against the negative externalities of knowledge spillovers. So the impact of knowledge spillovers on firms can be reduced.

Theoretical implication

In most of the research that is conducted on knowledge spillovers, these spillovers are seen as a positive because they increase the economic growth (de Faria & Sofka, 2010). This type of research is also conducted on an economy point of view. Other research that is conducted on firms and negative knowledge spillovers is mostly focusing on multinational firms.

In this research the approach will be different; it will be from a firm point of view and on the negative effects on knowledge spillovers. The firms that will be studied are the so-called SMEs. A third and also important factor is that this research will focus on the agro sector. In this sector so far no research has been conducted on the negative effects of knowledge spillovers.

1.2 Conceptual design

During this paragraph the conceptual design of the research will be discussed. This is an important part; according to Verschuren & Doorewaard (2010) the most important purpose of a conceptual design is steering. This does not only mean steering in the creation of the technical design, but also in the actual implementation of the research project later on (Management Studies / Business Administration Group, 2011).

1.2.1 Research objective

The research objective describes the motivation to do the research and what is hoped to achieve through the research (de Vaus, 2001). The objective of this research is to find out

how agricultural entrepreneurs should protect their valuable knowledge by assessing how the knowledge intensive agricultural entrepreneurs are tackling this problem.

However it is very difficult to measure the knowledge protection of SMEs, in order to overcome this “problem” dependent and independent variables have to be formulated.

Dependent variables

As suggested by Verschuren & Doorewaard (2010) it is useful to determine core concepts of the independent variables. These decisions of which core concepts to use is determined by previous research. According to De Vaus (2001) and dependent variable needs to be capable of change.

According to literature one way to check how successful a firm reduces the negative impacts of knowledge spillovers is to see how much the knowledge is actually secured (De Sofka & Faria 2010; Olander, Hurmelinna-Laukkanen & Mähönen 2009; Amara, Landry & Traoré 2008; Arundel & Steinmueller, 2007; Arundel 2001).

According to Leiponen & Byma (2009) the type of innovation/knowledge is important, as stated in their paper, there is a difference between product-/ and process innovations. So the type of knowledge/innovations that needs to be secured has an important influence on the success of the approach to reduce the negative impact of knowledge spillovers.

Another very important dependent variable could be the actual spillovers in a firm, this could be according to Olander et al. (2009), in their research it is stated that the type of knowledge spillover a firm is suffering from is important and also the frequency when it happens is an important factor to determine how successful a firm is in protecting their knowledge.

Closely related to the suffering of knowledge spillovers; is the amount of knowledge that spills over to competitors, or spills out of the firms (new organizations that are set up by formal employees). This is one of the variables that Olander et al. (2009) used during his research.

Gallié & Legros (2012) used the type of knowledge protection as a dependent variable. This means that they researched what type of protection mechanisms firms used to safeguard their innovations. With the type of knowledge protection methods used is meant the informal methods that firms can use to protect themselves against the undesirable effects of knowledge spillovers. These are lead time, secrecy and Human Resource Management (HRM).

- **How much is the knowledge secured**
- **Type of knowledge protection**
- **Actual suffering from knowledge spillover**
- **Type of knowledge/innovations that needs to be protected (product/process)**
- **Amount of knowledge that spills over**

As can be seen some of the variables have some overlap. Especially the last and the third one. The amount of knowledge that spills over has a very strong connection with the actual suffering from knowledge spillovers.

Independent variables

However it is also important to identify the factors that are influencing the dependent variables.

Firm size is an important variable, in literature there is a lot of discussion going on whether firm size has a positive or negative influence on knowledge spillovers/innovations. In research there is evidence that is in favor of SMEs because they are more flexible and also in favor of larger firms because of the higher amount of resources available. (Symeonidis, 1996). So firm size is an important control variable. Another control variable could be the firm age. According to Thornhill (2006), firm age is negatively correlated with innovativeness especially in high technology sectors.

Types of innovations are according to Leiponen and Byma (2009) an important variable because product innovations are more likely to be patent than process innovations. So the knowledge used to develop product innovations is more likely to be patented than knowledge used for process innovations.

The industry where a firm is operating is a moderating variable according to literature. The type of business a firm operates has a direct effect on which knowledge protection methods are selected, for example in service companies HRM is more effective than lead time (de Faria & Sofka, 2010), as can be seen in Figure 1-1. According to Verschuren en Doorewaard (2010) this variable is called a moderating variable.

The competitiveness of the industry has an influence on the selection of the protection methods and the success of these methods according to Thornhill (2006). In other words dynamism. "Dynamism refers to the degree of uncertainty and turbulence in market and industry conditions, including the state of technology and overall economic performance" (Thornhill, 2006).

Levels of knowledge assets/knowledge intensity within a firm are an important indicator of a firm's innovativeness. Firms with high knowledge intensities are likely to have knowledge protection policy because knowledge is valuable to these firms (Delereu & Lajeune, 2010). A more detailed description can be found in paragraph 3.1 of the proposal. Closely related to the previous statement are the R&D expenditures, it is likely that a firm uses knowledge protection mechanisms when it invests in R&D, for these type of firms knowledge is important (Gallié & Legros, 2012).

An important independent variable that influences the choice of the protection mechanisms is knowledge employee turnover (Gallié & Legros, 2012). When a firm suffers a lot from the fact that knowledge workers leave the firm frequently it is likely that the firm will come up with specific HRM policies, which in case will affect the choice of protection mechanisms.

Independent variables are:

- **Firm Size**
- **Firm Age**
- **Type of innovations**
- **Type of industry**

- **Competitive environment**
- **Knowledge intensity**
- **R&D expenditures**
- **Knowledge workers turnover**

In Figure 1-1 a graphical overview of the conceptual design of the research is presented.

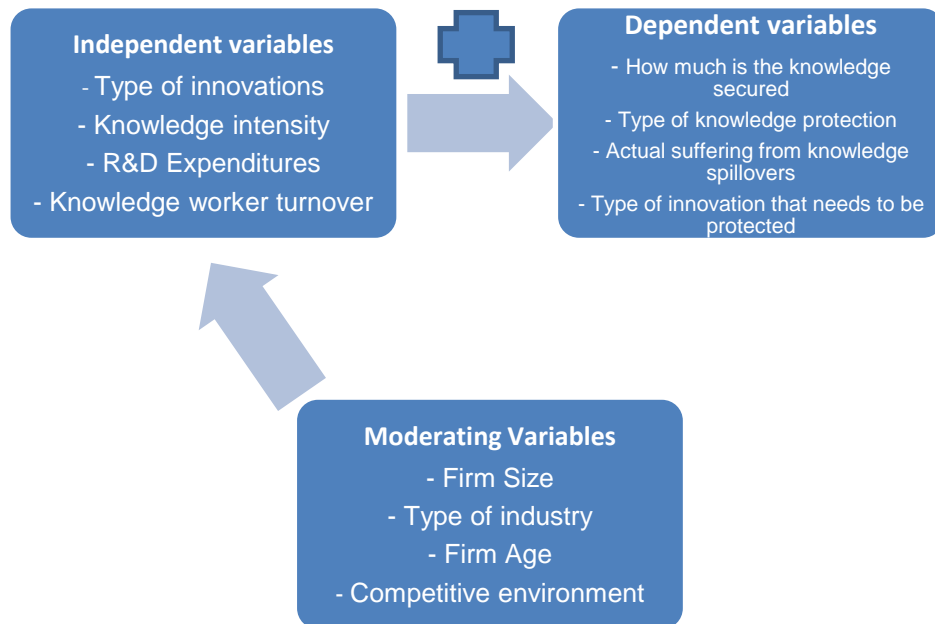


Figure 1-1 Conceptual design

The project is a theory-oriented research; first knowledge needs to be gained about knowledge protection in SMEs. However this does not mean that this project doesn't have any practical relevance. This project will contribute to the knowledge of how to protect agricultural firms against undesired knowledge spillovers and which methods/interventions are most successful (Verschuren & Doorewaard, 2010). This will be done by testing current theories in practice by conducting interviews.

To test the theory a more quantitative method will be applied, this is very suitable for a theory testing approach that this research carries. The indicators of the variables are written down below the variables in Figure 1-1. Firms try to reduce the negative effects of knowledge spillovers by using protection methods i.e. formal protection methods and informal protection methods.

1.2.2 Research framework

According to Verschuren & Doorewaard (2010) is the process of making a research framework a useful step between the research objective and the formulation of the research questions.

Furthermore, a research framework is important for establishing the theoretical background, such as the key concept, the theoretical framework, etc..

The research framework consists of different sections. First a literature study will be carried out; afterwards the theoretical framework will be designed. Then the interview in which the data will be collected will be made and checked before actually carrying out the interview. Then the results will be analysed and conclusions and recommendations will be written. The graphical representation is stated on the next page in Figure 1-2.

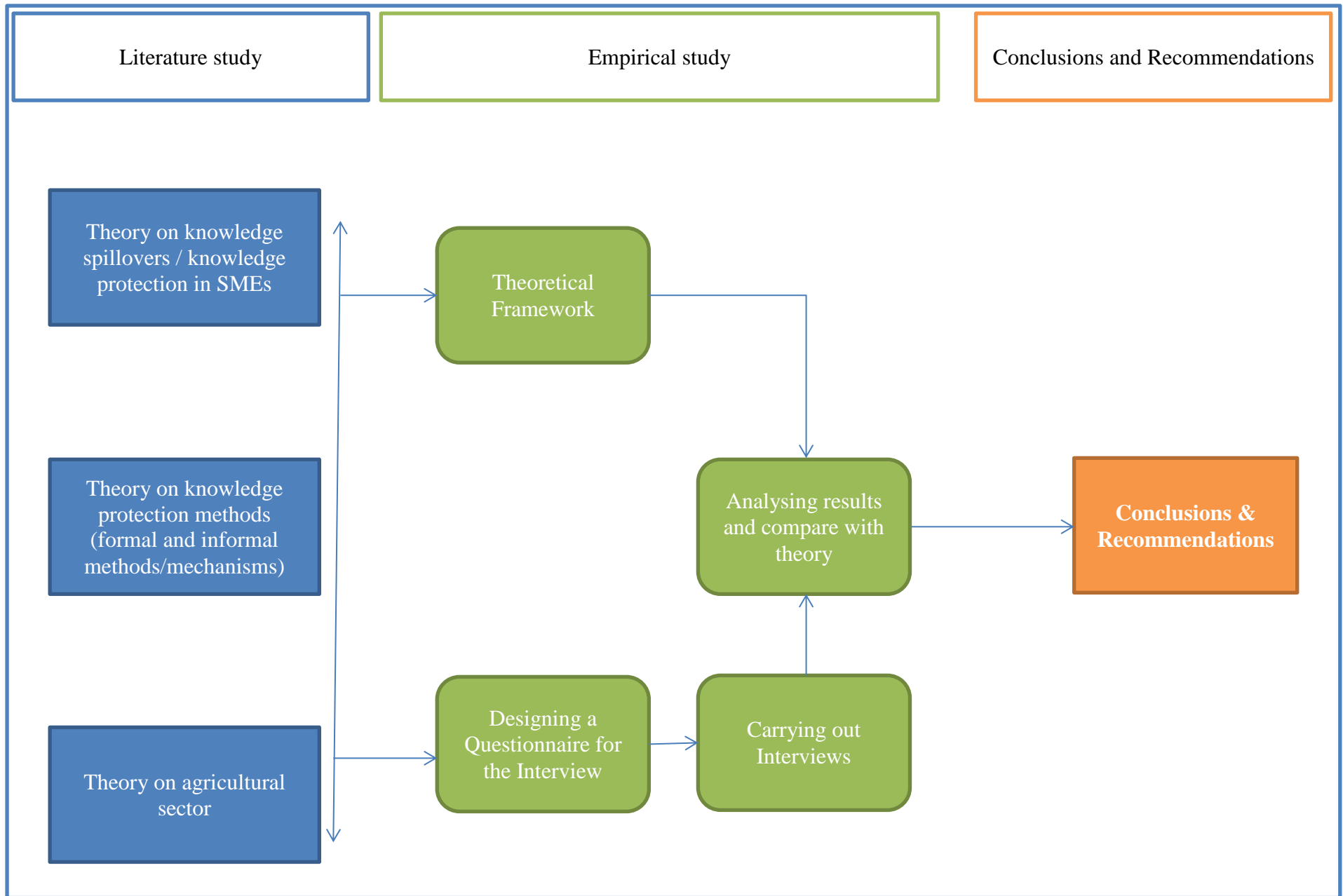


Figure 1-2 Research framework

1.2.3 Research issue

According to Verschuren & Doorewaard (2010) the research questions must be formulated in a way that they can be answered during the research project. Besides a general research question, several sub-questions will be formulated (called research questions) which makes it possible to answer the general research question during the conclusion of the thesis.

The research questions have been made up with by subdividing the research framework; the research framework is divided into a subset of components. This method is one of the methods that are suggested by Verschuren & Doorewaard (2010). The research framework is divided into a literature part and an empirical part.

General research question

How can Dutch agro sector related SMEs protect themselves against the negative externalities of knowledge spillovers by using protection mechanisms?

The general research question focusses on the best knowledge protection mechanisms, however as already can be read in the introduction and further on in the report during the literature study. The selection depends on many reasons and depends on many factors of the firm. So we will make the assumption that the most used knowledge protection mechanisms are the most effective protection mechanisms for agro sector related SMEs. For this research it is assumed that entrepreneurs and managers choose the protection mechanisms in which they trade off costs and benefits. So the entrepreneurs/managers would choose the most effective and efficient knowledge protection mechanisms that would fit their firm.

However this general research question cannot be answered directly, to answer this question several research questions are constructed.

Research questions

1. What are the negative effects of knowledge spillovers?
2. What are the most important formal and informal knowledge protection mechanisms and what are their strengths- and/ weaknesses?
3. What are the most important knowledge protection mechanisms for knowledge intensive SMEs?
4. Which protection mechanisms are perceived with the highest satisfaction by Dutch agro sector related SMEs?
5. How does the Dutch agro related sector scores comparing with other industries?

The first three research questions are theory related and the research questions 4 & 5 are related to the empirical part of the research. During research question 5 a comparison will be made with other agro related sectors for example horticultural subsectors.

1.2.4 Key definitions

To increase the clarification of the project, some of the main concepts are described below.

- **Knowledge;**

According to uit Beijerse (2000) Knowledge means the capacity to make information from data and to transform it into useful and meaningful information.

- **Knowledge Spillover;**

According to (Eeckhout & Jovanovic, 2002), spill overs consists of knowledge flows from leaders to followers. However Olander et al. (2009) concludes that not only leaders (large firms) suffer from spill overs but also SMEs. So for this research widens the view of Eeckhout & Jovanovic (2002) and states knowledge spill overs as knowledge flows from firms/institutions to other firms/institutions.

- **Knowledge protection;**

Multiple researches have shown that firms need to use protection of knowledge to appropriate their knowledge (Gallié & Legros, 2012). Various mechanisms can be used to protect knowledge (Gallié & Legros, 2012) (Delerue & Lejeune, 2010) (de Faria & Sofka, 2010) (Amara, et al., 2008).

- **Knowledge intensive economy;**

According to the Oxford Dictionary this means an economy in which growth is dependent on the quantity, quality, and accessibility of the information available, rather than the means of production. This is in line with Delmar & Wennberg (2010).

- **Agriculture;**

According to the Oxford dictionary the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products.

- **SMEs;**

According to the Dutch standard of SMEs (MKB Nederland, 2012) a company with less than 250 employees.

2 Theoretical framework

During this chapter the theoretical questions that have been formulated in the previous chapter will be tried to answer. These questions are also the basic input for the questionnaire that will be carried out during the interviews.

The questions that will be answered during this chapter are the following.

- *What are the negative effects of knowledge spillovers?*
- *What are the most important formal and informal knowledge protection mechanisms and what are their strengths- and/ weaknesses?*
- *What are the most important knowledge protection mechanisms for knowledge intensive SMEs?*

The questions will be answered by describing the most important and relevant theories that exist on this specific field. All research questions will have a specific paragraph in which they will be discussed and concluded.

2.1 Knowledge spillovers

During this paragraph the first theory oriented research question will be answered. However before the negative effects of knowledge spillovers can be stressed, knowledge spillovers itself needs some introduction.

For decades economist have tried to explain economic growth (Hallin & Holmström Lind, 2012). Many models have tried to explain these phenomenon. One of the most well-known was the paper and model of Solow (1957). This model has been build up by production factors as labour and capital. This model could explain perfectly what happens to an economy when production factors changed. However in the long-term the Solow model always returns to a so-called steady state, in this situation the economy is constant. In the real world this isn't the case because there are many countries that are able to perform long-term economic growth, something that is not possible with the basic Solow model (Mankiw & Taylor, 2008). With long-term economic growth the economy becomes more efficient, higher production per working hour can be achieved. The only explanation that exists for this phenomenon are innovations. This however doesn't mean that all innovations lead to economic growth; because for example if the market is not ready for a certain product or consumers cannot afford the innovation there will be no sales. In one of the most influencing papers on economic growth, Romer (1986) stressed the crucial role for knowledge in economic growth (Acs, et al., 2009) (Tappeiner, et al., 2008).

However knowledge itself cannot cause innovation, however it is the combination of knowledge that leads to innovations. When knowledge meets in certain place at certain times it can lead to the development of new products or processes (uit Beijerse, 2000). Another thing about knowledge is that it has always the tendency to spill-out. According to Eeckhout & Jovanovich (2002), spill overs consists of knowledge flows form leaders to followers. However Olander et al. (2009) states that not only leaders (large firms) suffer from spill overs but also SMEs. So this research widens the view of Eeckhout & Jovanovic (2002) and states knowledge spill overs as knowledge flows from firms/institutions to other firms/institutions.

These knowledge spillovers have an enormous effect on the behaviour of the economy and firms. As already discussed for the economy knowledge spillovers can have a very positive effect. However on firm level there are two sides of the medal (Amara, et al., 2008). On the one hand firms can profit from knowledge spillovers because the spillovers allow them to profit from knowledge that they didn't invest in or not as much as the original inventor/creator of the knowledge (Chyi, et al., 2012). So there can be said that the overall performances of firms in a sector improves. This investor/creator can be for example an university, in this case it is the intention the spread the knowledge, or it can be another firm/individual (Delmar & Wennberg, 2010). In case of the last we come to the problem of knowledge spillovers namely the negative externalities knowledge spillovers can cause (Gallié & Legros, 2012). With a more open innovation systems firms are able to profit from each other's knowledge and the economy will grow faster. From economic growth a lot of people can profit because it creates more jobs, less unemployment, higher welfare etc.. Economists already try for decades to predict economic growth and many publications there have been on this topic (Thornhill, 2006). However there are also arguments that prefer knowledge protection because in a system where knowledge can be protected firms have more and more incentives to innovate because their investments in new products/processes can be protected so they can benefit from it (Gallié & Legros, 2012); when firms have less incentives to innovate because of not proper protection the economic growth will decrease because there is less innovation (Harabi, 1995). For SMEs proper protection is also important because it focusses more on niche markets (Delerue & Lejeune, 2010), due to economies scale it is hard for SMEs to compete with large firms (this can be read in paragraph 2.3).

Knowledge spillovers are very complex because they occur in many different forms (Delmar & Wennberg, 2010) (Cassiman, et al., 2002), knowledge spillovers can happen to competitors, suppliers/customers or to new types of businesses (Hallin & Holmström Lind, 2012). The existence of these spillovers and their effects has a significant effect on the innovation efforts of firms (de Faria & Sofka, 2010) (Amara, et al., 2008) (Fritsch & Franke, 2004). Another aspect that increases the need of knowledge protection is the global competition which makes achieving a competitive advantage even more complex (Bader, 2007), however it makes it also more expensive to protect knowledge (Arundel, 2001). This is also stated by Delerue & Lejeune (2010), who state that "imperfect resource mobility generates a competitive advantage". In the previous part of this report has been explained that firms need to innovate in order to achieve a competitive advantage (Delerue & Lejeune, 2010). However firms also want to optimize the future profits of these innovations, so-called appropriation (Levin, et al., 1987). It is however difficult to measure how much a firm is suffering from knowledge spillovers. However according to literature there are important measurements which can predict the suffering of firms. These measurements are stated below.

Imitation of products/knowledge

Imitation of products/knowledge is one of the most important reasons why negative effects of knowledge spillovers exist as shown in literature (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Amara, et al., 2008). Eeckhout & Jovanovic states "that it is generally well understood that safeguarding the discoveries from copying is needed", followers (competitors) will always watch with which kind of innovations a certain firm comes up. When this innovation is promising they will try to benefit from it by copying it or at least some of it (Eeckhout &

Jovanovic, 2002). This however gives innovative firms less intentions to innovate when they are not able to protect their innovations/knowledge because the followers can copy it with making less investments (Gallié & Legros, 2012) (Acs, et al., 2009) (Eeckhout & Jovanovic, 2002).

Knowledge workers retention

As already has been stated in the previous chapters, knowledge spillovers have a negative effect on firms. “When the economy performs well, there are many opportunities for talented people to look for jobs elsewhere. When the economy is not doing so great, organizations want to make sure that they still have their best people to carry them through the tough period” (Vainman, 2008). When knowledge workers leave the firm it can cost firms a large amount of money for example for recruiting, hiring and training new employees; however these are only the “hard costs”. But there are more less visible costs, the so-called “soft-cost”; these costs consist of the loss of experience, skills and relationships of the knowledge worker who left the firm (Vainman, 2008) (Dahlgaard & Dahlgaard, 2003).

Vainman (2008) estimates the hard costs of the loss of a knowledge worker on \$ 35.000, -- / \$ 100.000,--. When you add the soft costs he states that the cost would at least double. This is a general understanding in literature however it is very hard to measure what the real cost would be. However it can be concluded that the retention of knowledge workers is/should be an important part of a firms policy. And the knowledge worker will take the previous mentioned characteristics with him to his next job which could be a competitor and this of course would increase the total damage to the firm.

Spin outs

Spill outs are a special type of knowledge worker retention. When a spill out is occurring a knowledge workers leaves the firm and start up a firm of his own. According to Delmar & Wennberg (2010) “these agents – individuals or firms – try to commercialize new knowledge by setting up a new firm. The creation of new firms can be seen as either a subgroup of employee mobility between firms or a fourth way for knowledge spillover to take place, where employees leave a firm to utilize the experience and knowledge acquired with the former employer by setting up a new firm that might become a potential future competitor” (Delmar & Wennberg, 2010).

There can be concluded that firms can suffer a lot from the negative effects of knowledge spillovers. This also explains the efforts of knowledge intensive firms in knowledge protection. Except for the fact that it can costs firms a lot of money a spillover can also make that a firm loses his competitive advantage or even create an extra competitor.

2.2 Protection mechanisms

The importance of knowledge management and protecting knowledge has been stressed in the previous paragraph. Because of this reasons managers have strong incentives to protect as much knowledge as possible (Mansfield, 1986). In order to protect knowledge certain mechanisms/methods exist that can help firms protecting their valuable knowledge and innovations.

According to literature multiple mechanisms/methods (also called appropriability regimes) exist to protect knowledge. Whether it includes technical or organisational knowledge

(Teece, 2000). The protection mechanisms have to fulfil different conditions; according to Hurmelinna-Laukkanen (2009) the first condition would be protection the invention and the second condition would be securing the possibility to create profit and exploit the exclusivity of the invention/knowledge as can be seen in Figure 2-1.

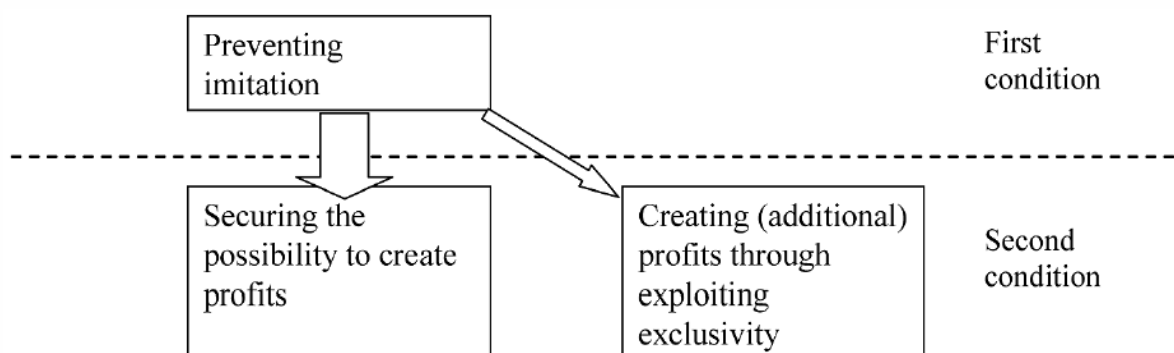


Figure 2-1 Functions of protection mechanisms (Hurmelinna-Laukkanen, 2009)

This has also been stated in other publication by other authors. Cohen and Walsh (2001) were the first that defined this (basic) model. They also stated that the “first condition is to prevent or, at least, delay imitation” (Cohen & Walsh, 2001)

Another frequently used argument in favour of knowledge protection is that “innovation amounts to knowledge production, but knowledge is inherently non-rival, even when it is embedded in new products or technologies, this will cause the market to fail and brings insufficient motivation to innovate” (Encaoua, et al., 2006). With other words there is a need for knowledge protection in order to keep firms innovating; otherwise firms will not have any incentive to innovate (Hall, et al., 2012).

This argument is contrary to the argument of proponents of open innovation. They state that through knowledge protection the innovation process is delayed and economic growth delays. However the ones in favour of knowledge protection counter these arguments by the arguments stated in the previous indentation. In this research we choose the view of Hall (2012) e.o. that firms need to protect their knowledge in order to have incentives to innovate.

This can be achieved by using protecting mechanisms (or appropriability mechanisms).

“Appropriability mechanisms enable a firm to prevent or, at least, to limit imitation of its core intellectual assets and the products and services based on them, which means that it can profit more from intangibles than it would if competitors had direct access to them” (Atkins, 1998)

To underline the importance of knowledge protection and the damage of the negative externalities of knowledge spillovers former CEO of Hewlett Packard (HP) Lew Platt stated:

“If only HP knew what HP knows, we would be three times more productive” (Teece, 2000).

It is general understood that knowledge is more valuable for knowledge intensive firms than for not knowledge intensive firms, the knowledge intensive firms should then of course have a higher incentive to protect their knowledge (Hurmelinna-Laukkanen, 2009).

In literature often different names are used but the protection mechanisms can be divided in two parts. Namely knowledge protection methods that carry legal protection and can be codified and protection mechanism who can't (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Olander, et al., 2009) (Amara, et al., 2008) (Harabi, 1995). Most frequently names used in literature are formal/informal (de Faria & Sofka, 2010), statutory/non-statutory (Gallié & Legros, 2012), formal/strategic (Amara, et al., 2008), codified/tacit (Teece, 2000) et.. However the meaning of this typology is in all the research the same. So for this reason it is chosen to work with formal and informal as stated in the paper by Hall, et al. (2012) and de Faria & Sofka (2010).

2.2.1 Formal protection mechanisms

As already has been stated formal protection mechanisms contained codified information and carries legal protection (Gallié & Legros, 2012). During this paragraph different formal protection mechanisms will be discussed. Because there are multiple mechanisms of formal protection we will use the mechanisms mentioned by Gallié and Legros (2012); because this paper gives a detailed overview of the most important formal protection methods. In this research, formal protection methods as patents, design registration, trademarks and copyrights are discussed. Another method used in agriculture are the plant breeding rights, these rights are not used in the dairy sector but in the plant breeding sector. This is also an important sector is Dutch agriculture (Winnink, 2012). The last research question is about the comparison with another sector, this sector is the plant breeding sector so a description of breeding rights can also be found in this paragraph.

2.2.1.1 Patents

According to Harabi (1995) and Arundel (2001) the most used and well known formal protection method is the use of patents. A relative large amount of research already has been done on this topic, this because there are relatively large patent databases and easy accessible (Arundel & Steinmueller, 1998). On the internet relatively easily an overview can be found of the total patent registrations (EUROSTAT, 2008). Other formal protection mechanisms are relatively less used (Hertzfeld, et al., 2006). Blind et al. (2006) ranked to most important motives to patent as can be seen in Table 2-1.

Table 2-1 Ranking significance of motives to patent in recent empirical studies (Blind, et al., 2006)

| | Arundel et al., 1995 (1993) | Duguet and Kabla, 1998 (1993) | Cohen et al., 2002 (1994) | Pitkethly, 2001 (1994) ^b | Schalk et al., 1999 (1997) | OECD, 2003 (2003) ^{c,d} |
|----------------------------------------------------------|--------------------------------|----------------------------------|------------------------------|----------------------------------------|-------------------------------|-------------------------------------|
| Traditional motive | | | | | | |
| Protection from imitation | 1 | 1 | 1 | 1 | 1 | – |
| Strategic motives | | | | | | |
| Defensive blockade | 3 | 2 | 3 | – | 2 | 3 ^e |
| Offensive blockade | – | – | 2 | 2 | 3 | – |
| Reputation/technical image | – | – | 5 | – | 6 | – |
| International market extension | 5 | 5 | – | – | – | 4 |
| Internal performance indicator/motivation | 6 | 6 | 7 | – | 5 | – |
| Exchange potential/negotiating mass | 2 | 2 | 4 | 3 | 4 | 2 |
| Licensing revenues | 4 | 4 | 6 | 4 | 7 | 5 |
| Make own invention the standard | – | – | – | 5 | – | – |
| Capital market | – | – | – | – | – | 6 |
| Forced to patent because of patent practice of others | – | – | – | – | – | 1 |

“A patent is presumed to be the strongest form of intellectual property protection. It confers on the inventor the right to exclude other from economically exploiting an innovation for a limited time” (Gallié & Legros, 2012). In order to get a patent in Europe and many other countries, an applicant has to disclose enough information; so a patent includes a very detailed overview of the invention (Arundel & Steinmueller, 1998). A patent also has a specific time in which it can be used, in general 20 years.

According to Encaoua et al. (2006) patents are considered as a valid policy instrument to overcome market failure. Because when there is no protection of knowledge this will cause market failure because firms do not have any incentive anymore to innovate. “Patents are an ex-ante protection mechanisms, which gives the inventor or the issuer of the patent the exclusive right to use the invention and appropriate his investments” (Encaoua, et al., 2006). Another benefit is that it is protected by law, so the firms property is protected. Which again has a positive influence on a firms decision to innovate.

According to Harabi (1995), patents have more benefits. Except for the fact that the can secure protection against imitation they can also be used to secure license fees (Harabi, 1995). In exchange for a fee, a firm that own the patent can give permission to other firms to produce certain products conform the patent.

Besides the advantages patens have also some disadvantages which will influence the choice of firms to apply for patents (Harabi, 1995). As stated by Harabi (1995), only a small part of the firms applies for a patent in order to receive licences fees (royalties). The fact that patents carry legal protection doesn't mean that the government enforces patents; this is the responsibility of the patent owners (Amara, et al., 2008). So the firm who are owner of patent needs to check by themselves if another firm infringes on their patent. If so they need also to take action by themselves.

A major disadvantage of patents is that in order to get a patent is that it requires a high amount of detailed information in exchange to get the patent granted (Mansfield, 1986). This high amount of information could be a threat to many firms according to Arundel & Steinmueller (1998), because patents are relatively easy to localize/find with the use of internet, however additional cost/the time it consumes for searching can be a reason not to look into patent databases. Also a lot is known in technological literature, which can be used

by firms so that they do not have to pay for patents files (if money is charged for that, for example a lot of patents are also free online of on the internet (Hall, et al., 2006)).

Another possible disadvantage of a patent can be the fact that it is an ex-ante protection mechanism, so it offers no protection during the development phase of an innovation (de Faria & Sofka, 2010). Also there needs to be stated that not all information can be codified and is therefore not patentable.

Multiple research also states that the cost for acquiring a patent can be perceived as too high (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Amara, et al., 2008), in the Netherlands these costs are between € 2.500 and € 50.000 (Agentschap NL, 2012), besides to costs for applying for a patent there are also costs every year for keeping the patent valid. These costs depend on the fact in which countries a firm wants protection (these costs can add up to a total of € 250.000) etc. (Agentschap NL, 2012). Especially Small and Medium-sized Enterprises (SMEs) can lack resources to apply for patents (Leiponen & Byma, 2009); this will be discussed in more detail in the next chapter which is about SMEs. Another situation where patents are less applicable is a situation where innovation cycles are very short or a lot of sequential innovations take place (Arundel, 2001). The willingness to patent also depends highly on the industry and type of innovation. Product innovations are generally more suitable for patenting (Harabi, 1995), and industries as biotechnology, manufacturing also patent more frequently than for example service firms (Blind, et al., 2006).

2.2.1.2 Design registration

“Design registration gives the owner the legal right which protects the overall visual appearance of a product but does not protect what it is made from or how it works” (Gallié & Legros, 2012). This includes things like colour, lines, contours, shape, texture and materials which when it is applied to the product it will give the product its unique appearance.

Main disadvantage of design registration is that it is only about the visual appearance which has not a lot influence on knowledge or can be easily undermined by using different products and a slightly different outlook (Amara, et al., 2008); only a small part of the firms for which the construction/look determines the strength of the innovation design registration can be a good protection mechanism (de Faria & Sofka, 2010). In general the costs for a design registration are in the Netherlands between € 1.000 and € 3.000 (Agentschap NL, 2012). So in this perspective design registration is less expensive than patents and can be important for certain types of innovations.

2.2.1.3 Trademarks

According to Gallié & Legros (2012) is a trademark “a sign, word, symbol, or device that distinguishes the goods or services of one firm from those of others. No novelty or originality is necessary, but the main requirement is distinctiveness. Trademarks are valid if they are registered. Protection of trademarks does not have a time limit, provided they are used and renewed periodically”. According to Hannah (2005) trademarks are less valuable to protect business information because trademarks can only be granted for observable symbols that are associated with a specific firm, brand etc.. The costs for getting a trademark are in the Netherlands between € 1.000 and € 3.000 (Agentschap NL, 2012).

2.2.1.4 Copyrights

“As for copyrights, they protect original works of authorship. Unlike with patents, there is no novelty or usefulness requirement, although there are conditions as to originality (the work

has not been copied) and authorship” (Gallié & Legros, 2012). “Copyrights are usually applied in artistic works such as books or songs and cannot be applied to most forms of business information” (Hannah, 2005). For innovations copyrights are less valuable with some exemptions like software, it is not possible to use other forms of knowledge protection for this type of technological development. So in case of software development which requires also lots of knowledge copyrights can be important protection mechanisms. On the other hand a combination of a device and software can be patentable, the combination with a device is then required. The main advantage of copyrights is that they are for free, so no costs involved (Agentschap NL, 2012).

2.2.1.5 Breeders rights

Plant breeders rights are a protection systems that is special designed for breeders. It grants protection to the breeder of a new breed. The breeders right only exist for plants and mushrooms (Agentschap NL, 2012). For most crops the breeders rights last for 25 years and for some crops (i.a. potatoes, strawberries and apples) it lasts for 30 years. A new breed has to meet 4 conditions in order to get breeders right granted (Agentschap NL, 2012).

- Distinctness
- Homogeneity
- Stability
- Must be a new breed

The breeders right gives the owner of the right the opportunity to exploit the breed and profit from the investments. It gives the owner the right to forbid other to reproduce, handle, offer for sale, sell, import and export, or store propagation material of the protected variety. So when another farmer wants to use the breed he has to pay for it if the owner of the breed wants to sell. However there are some exemptions like the scientific research exemption and the breeders exemption. This means that the breeder cannot act against other parties that use his breed for scientific purposes and he can also not act against other breeders who try to create new breeds by using his breed as basic material (Louwaars, et al., 2009). Breeders can apply for two different rights, the national breeders rights and the European breeders rights. This means that for innovating and creating new breeds there is a kind of open innovation system which pushes innovation (Louwaars, et al., 2005).

Research has shown that for innovations only patents are used as a single mechanism, however also in multiple cases in cooperation with one of the other formal protection mechanisms (Amara, et al., 2008). Patents are also perceived as the strongest protection mechanisms according to Harabi (1995) & Arundel (2001). Olander et al. (2009) discusses also the formal protection method contracts, however the strength of this formal protection method depends highly on the way it is filled in and constructed; often contracts are incomplete due to asymmetric information and other agency problems like moral hazard etc. (Slangen, et al., 2008). This view is confirmed by Hannah (2005) who states that trademarks and copyrights can serve crucial purposes, but that organizations that want to protect their knowledge are likely to choose patents as a formal protection method.

The importance of legal knowledge protection by law is very important in sectors as plant breeding and the seed industry. In this sector new most new varieties are developed by specialised organizations who need the formal protection in order to secure their profits and try to create a competitive advantage (Louwaars, et al., 2005).

2.2.2 Informal protection mechanisms

As can be seen in the previous paragraph formal protection mechanisms have numerical advantages such as legal protection; but also disadvantages like costs, only valid for certain period of time, static character, etc.. There are types of knowledge where formal protection mechanisms doesn't work appropriate, for example the knowledge that is embedded in workers; it is impossible to formal protect these knowledge assets (Delerue & Lejeune, 2010), so informal protection mechanisms are needed. The most important informal protection mechanisms according to literature are: lead time, secrecy and Human Resource Management (HRM) (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Delerue & Lejeune, 2010) (Amara, et al., 2008).

de Faria & Sofka (2010) states: "In contrast to formal forms of knowledge protection, no knowledge codification or disclosure is required. This increases the effectiveness of strategic knowledge protection methods because they include the protection of tacit knowledge and towards opportunities for competitors to "invent around" patented innovations" (de Faria & Sofka, 2010). Opponents of informal protection mechanisms state that it offers no real protection because as soon as the knowledge leaks out, it cannot be protected anymore.

2.2.2.1 Lead time

Research has shown that lead time can be a very strong protection mechanism, especially for process innovations lead time can be beneficial (Harabi, 1995). With lead time is meant the time that a certain firm comes with an innovation and the time others need to copy this innovation or knowledge. In some circumstances like a fast changing environment lead time can be very beneficial (Olander, et al., 2009) (Lieberman & Montgomery, 1998).

According to Delerue & Lejeune (2010) does lead time allows a firm to gain a technological edge over the competition for a period of time. "This strategy consists of innovating more quickly than rivals" (Delerue & Lejeune, 2010). Harabi (1995) states that lead time is perceived on of the strongest protection mechanisms for process innovations. In order to pursue a lead time advantage a firm must innovate quicker than competitors (Gallié & Legros, 2012). A disadvantage of lead time is that it lasts only for a period of time and when a firm doesn't keep innovating after a certain amount of time it will lose the advantage.

2.2.2.2 Secrecy

"Firms that do not wish to disclose information can forgo patenting and use secrecy to protect their investment in the invention" (Arundel, 2001). Multiple surveys have shown that manufacturing firms give secrecy a higher average rating as an appropriation method for both product and process innovations than patenting (Arundel, 2001) (Harabi, 1995). Secrecy is defined as followed:

"A piece of information that is intentionally withheld by one or more social actor(s) from one or more other social actor(s)" (Scheppelle, 1988)

Secrecy is a form of organizational knowledge protection that can be a critical source of competitive advantage. These secrets are only known in the organizations that own them. However when competitors discover the secret the value of these secret diminish rapidly (Hannah, 2005). In 1993 Heffernan and Swartwood (according to Hannah, 2005) calculated that U.S. companies lost more than \$250 billion through mismatches in their secrecy in 1992.

Arundel (2001) carried out a research in which he compared patents and secrecy, in which he used the data from the European Community Innovation Survey (CIS, 1993) of which he used data of 2.489 R&D performing firms, he stated that the R&D activity had no influence whether or not to choose for patents or secrecy. The results show that the highest percentage finds secrecy more effective as appropriation methods than patents (all sizes).

According to Hannah (2005) there are 2 main different secrecy procedures used in practice; the first is trade secret access restriction procedures and the second is trade secret handling procedures. From all the informal protection mechanisms secrecy is probably the most frequently used (Delerue & Lejeune, 2011), also because secrecy gives the holder of the secret a possibility to appropriate returns from his secret until it is public known and this can last for decades (Delerue & Lejeune, 2011). However firms have to make a certain effort in protecting this secret otherwise competitors can profit easily from it and no legal protection can be offered by the government; which can cost firms a large amount of money when the secret leaks out (Delerue & Lejeune, 2011) (Hannah, 2005). In other words as long as the secret remains to be a secret it is valuable, but its value decreases rapidly after the secret became known. A secret itself has no legal protection however it is possible to make secrecy agreements in case of cooperation. So when one of the partners leaks out a secret and the other party can prove this, the judge can force the leaking party to pay a fine. However proving someone leaks out can be very difficult (Arundel, 2001).

2.2.2.3 Human resource management

Human Resource Management (HRM) is one of the most underestimated protection mechanisms for firms (Olander, et al., 2009). In terms of innovation and knowledge generation (knowledge) workers are of the most important sources (Olander, et al., 2011), especially in small firms. The loss of a knowledge worker can cost firms a lot of money; the replacement costs for hiring a new worker consist of training, recruiting and hiring new employees were estimated between \$35.000 –and \$100.000. This are only the direct costs; there are also indirect costs like the loss of experience, knowledge, skills and relationships, these soft costs are estimated at least at the same amount as the direct costs (Vainman, 2008).

In order to retain these knowledge workers, HRM has received an increased attention in research the last years (Wheeler, et al., 2012). This makes perfect sense because literature shows a relationship between HRM efforts and firm performance (Bowen & Ostroff, 2004).

But to make sure to retain knowledge workers it is important to keep them motivated and committed to the firm (Dahlggaard & Dahlggaard, 2003). According to Dahlggaard & Dahlggaard HRM needs to satisfy the core values of humans (which are related to the spiritual needs of human) and the core competencies (which are related to the satisfaction of humans mental and psychological needs). Multiple theories exist on how HRM could help managers to reduce workers turnover and increase motivation and commitment. Most of them are based on the pyramid of Maslow (as stated below in Figure 2-2).

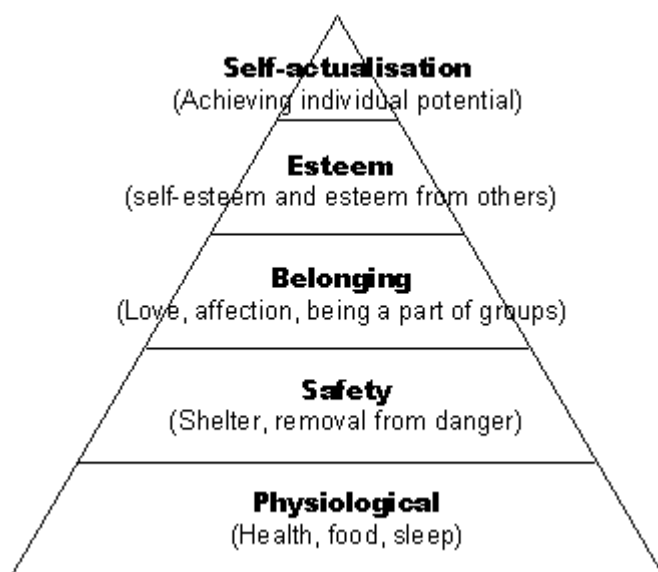


Figure 2-2 Pyramid of Maslow (Maslow, 1953)

Most of the theories are incomplete or focus on a small part of HRM, namely the physical or biological parts of HRM (Simmonds & Pedersen, 2006). However Dahlgaard & Dahlgaard (2003) argue that most of the existing research ignores the spiritual dimension of satisfying human needs (personal core values); they suggest the use of the so-called Trinity model in order to achieve a high satisfaction of workers, because this model takes the spiritual dimension in consideration. The model is presented in Figure 2-3.

| Physical or biological needs (living) | Mental/psychological needs (learning) | Spiritual needs or core values (loving) |
|---------------------------------------|---------------------------------------|-----------------------------------------|
| Food | Sense of belonging | Searching and creating meaning |
| Water | Friends (mental love) | Trust |
| Air | Sex (mental love) | Justness |
| Shelter | Recognition | Honesty/openness |
| Clothing | Individual identity | Loyalty |
| Safety | Achievement | Integrity |
| Sex (biological) | Learning | Charity (Spiritual love) and sharing |
| | Creativity | Fairness |
| | Development | Respect |
| | Self-fulfillment | |

Figure 2-3 Trinity Model of human needs (Dahlgaard & Dahlgaard, 2003)

All three factors mentioned in the Trinity model are assumed to be crucial in human motivation. Also important is to mention that the factors are interrelated, for example people do not buy a house only for shelter anymore, but also to demonstrate their wellbeing, identity etc..

Dahlgaard & Dahlgaard (2003) states that “managers need to understand all three factors and the fact that they are interrelated and need to work on the various dimensions of needs, not only to achieve employee satisfaction and commitment, but also to improve the quality of

employees' working life". The first dimension (physiological a biological) is mostly satisfied so it is important to focus on the other two dimensions according to Dahlgaard & Dahlgaard (2003). It is important for an employee to feel recognized; this can be done by using his input and ideas in the innovation process. In this way the employee feels that he adds something to the firm. Also the opportunities to develop themselves as person and worker are very important for employees. As can be seen in the trinity model the dimensions are interrelated, when an employee is working in the innovation process he also feels trusted, respect. Things as career planning, involvement, personal contact are very important parts of HRM.

An important indicator for firms to check if they are doing a good job are personnel turnover measurements, for example how many employees are joining the competitor are starting up their own business. These indicators all tell something of how a firm is performing on HRM (Simmonds & Pedersen, 2006).

It can be concluded that in line with the formal protection mechanisms, informal protection mechanisms are not mutually exclusive. For example in order to maintain secrecy, good HRM management is required in order to retain the valuable workers with specific knowledge for the firm. Also combinations with formal protection methods are not unknown in the business world.

2.3 Knowledge protection in SMEs

"Small and medium sized enterprises (SMEs) have a reputation as boosters of employment, economic growth and economic dynamics. One of the most important means through which SMEs are able to make these contributions is their capability to realise innovations. Therefore, in both developed and developing countries and regions, many efforts have been made during the last few decades to stimulate SMEs to realise innovations" (Keizer, et al., 2002).

So as stated in the above mentioned citation SMEs play a crucial role in the current economy nowadays (Audretsch, 2002). According to Bacon & Hoque (2005) two-third of all European jobs are in SMEs. SMEs can often react more quickly to changes in the environment than larger firms due to their flexible character and smaller size (Leiponen & Byma, 2009). On the other hand SMEs need to be innovative in order to keep ahead of competition because on price etc.. This because it is likely that they will lose the competition on the large markets on price because large firms can exploit economies of scale (Keizer, et al., 2002). They will have a hard time to compete with the larger firms (Blomqvist, et al., 2005). According to Vossen (1998) there are some fundamental differences between SMEs and large firms (> 250 employees).

Table 2-2 Differences between SMEs and larger firms (Vossen, 1998)

| Relative advantages SMEs | Relative advantages Large Firms |
|-------------------------------------------------------|------------------------------------------------------------|
| Less Bureaucracy | Able to control organisation with formal management skills |
| Quick decision making process | Ability to spread risk over whole portfolio |
| Risk taking entrepreneurship | Functional expertise in staff |
| Motivated and committed management | More specialist labour |
| Motivated employees | Time and resources for extensive R&D projects |
| Quick and effective communication inside firm | Extensive distribution and services facilities |
| Quick response to changing markets | Large market power |
| Able to dominate small niche markets | Economies of scale and scope in R&D |
| R&D efficiency | Own R&D resources (laboratory) |
| Able to deliver custom made | Access to external capital |
| Able to learn quick and change processes and Strategy | Better able to realise diversification and synergy |
| | Able to absorb new knowledge and technology |
| | Able to build up entry barriers |

The above mentioned differences between SMEs and larger firms have also their influence on the innovation behaviour of firms and how to handle their knowledge. The most frequent stated problem is that large firms lack specialist to do certain innovations projects, this is for them a reason to cooperate with SMEs during such projects. The danger exists then for SMEs that larger firms have access to their knowledge and for example their knowledge workers (de Jong, 2006). This is the reason why in this paragraph the knowledge protection mechanisms of SMEs will be studied and so an answer will be formulated for the last theory oriented research questions.

However for innovations is knowledge needed, and not all SMEs possess this knowledge. Especially for whole new products which are developed in large R&D project, SMEs frequently lack resources (Olander, et al., 2009). So in order to gain knowledge about knowledge SMEs frequently have to cooperate with larger firms that have the resources to perform large R&D projects. This is called the knowledge protection/sharing dilemma (Olander, et al., 2009) (Dickson, et al., 2006), as can also be seen in Figure 2-4. Because once the knowledge is gained firms need to protect it in order to stay ahead of competition.

| | <i>Value/Innovation creation</i> | <i>Value capturing/ Profiting from innovation</i> |
|-----------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Knowledge sharing | Needed for creating new innovative combinations and ideas; may cause losing core knowledge assets to rivals | Needed for getting access to markets; may cause losing competitive edge |
| Knowledge protection | Needed for safe disclosure of existing knowledge; may prevent adequate knowledge flows | Needed for protecting the investments in innovation, needed for safe disclosure; may cause slower diffusion |

Figure 2-4 Knowledge sharing/protection dilemma (Olander, et al., 2009)

SMEs can make use of the same protection mechanisms as larger firms, however due to their size they can have different preferences. Thereby do SMEs frequently lack resources in

comparison with larger firms and this could influence their decision making for certain cooperation's or knowledge protection strategies (de Faria & Sofka, 2010).

2.3.1 Formal protection mechanisms

As already been stated in the previous section patents are the most important and most used formal protection mechanism. During this chapter we will focus on the SME related literature about knowledge protection.

Patents are not frequently used for protection of knowledge/innovations by SMEs, but also the other way around; patents are not often used as data gathering about competitors (Arundel & Steinmueller, 1998). A reason not to patent is the lack of resources that SMEs can experience (Leiponen & Byma, 2009) (Olander, et al., 2009). The amount of data that needs to be included in a patent which can be used by competitors is a second reason why SMEs and also larger firms do not patent their innovations/knowledge (Amara, et al., 2008). And a third reason for firms not to use formal protection methods is the character of knowledge. Often knowledge has a "tacit" nature, which makes it difficult to codify (Hurmelinna-Laukkanen, 2009). Another reason stated by Olander, et al. (2009) is that the cost of enforcing patents can turn out to be too high. Patents offer legal protection however firms have to enforce the patents themselves (Arundel, 2001). However patents can be very beneficial for science-based or capital-financed small firms, like the development of new species of potatoes (Louwaars, et al., 2005) (Gans, et al., 2002).

As stated in the previous section, SMEs frequently cooperate with larger firms in order to gain knowledge in order to pursue large R&D projects. In order to pursue a successful cooperation with larger firms contracts can be very helpful for SMEs. Because intellectual capital is a critical asset in the knowledge based competition and the discussion about ownership is likely to emerge at some point of the competition (Blomqvist, et al., 2005). However contracting doesn't mean that with a contract all discussion is solved, trust is also very important. When a firm is likely to contract a lot the cooperating firm can experience this as distrust in their cooperation (Slangen, et al., 2008). This will raise the agency cost for making a contract. Also factors as culture, characteristics etc. influence the agency cost of setting up a contract (Blomqvist, et al., 2005) (Blomqvist, 2002). So there should be a balance between contracting and trust and this balance differs in every specific circumstance. However it is important to mention that trust cannot protect knowledge and contract can. Another problem with contracting is the often weak bargaining power of SMEs (Olander, et al., 2009), and also the cost for maintaining them (monitoring and enforcing). An often applied method in contracting of employees is the non-competing agreement. This means that an employee cannot easily move to a competitor unless he pays a certain fee; or he cannot contact clients of his former employer (Fallick, et al., 2006). In the Netherlands such a mechanism is not a very strong protection mechanism because it normally lasts for 1 – 2 years and afterwards the employees are free to work everywhere. Also there are a lot of possibilities to let this type of contract be terminated by court (De Arbeidsrechter, 2012); for example when a contract is ended or when a certain employee is fired etc..

As has been stated by Gallié & Legros (2012), SMEs often serve niche markets, these markets are for larger firms less attractive because these markets are not that large, economies of scale cannot be applied and require the firms to meet specific consumer demands. Because of this, formal protection mechanisms can be perceived less valuable.

As can be concluded, formal protection mechanisms can be of helpful for SMEs however, due to the fact that they are expensive etc. they are less likely to be pursued by SMEs. In case of cooperation it can be useful to make use of contracts.

2.3.2 Informal protection mechanisms

Although it depends highly on the business environment, literature states that informal protection mechanisms are more frequently used then formal protection mechanisms by SMEs (Olander, et al., 2011) (Olander, et al., 2009) (Hurmelinna-Laukkanen, 2009) (Keizer, et al., 2002) (Arundel, 2001).

Literature states a few reasons:

- SMEs are flexible, dynamic firms and formal protection mechanisms are rather static (Olander, et al., 2011).
- Amount of data needed in order to get a patent granted (Arundel, 2001) (Harabi, 1995).
- SMEs lack resources in order to apply for a patent or other formal protection mechanism (Gallié & Legros, 2012) (Olander, et al., 2009) (Encaoua, et al., 2006).
- Type of knowledge/innovation is not suitable for formal protection mechanisms (Gallié & Legros, 2012) (de Faria & Sofka, 2010) (Hurmelinna-Laukkanen, 2009) (Amara, et al., 2008).

Now we will discuss the three most important informal protection mechanisms as stated by literature and also analysed in the previous chapter. In a study conducted by Olander, et al. (2009) several protection mechanisms were compared against each other as can be seen in Figure 2-5.

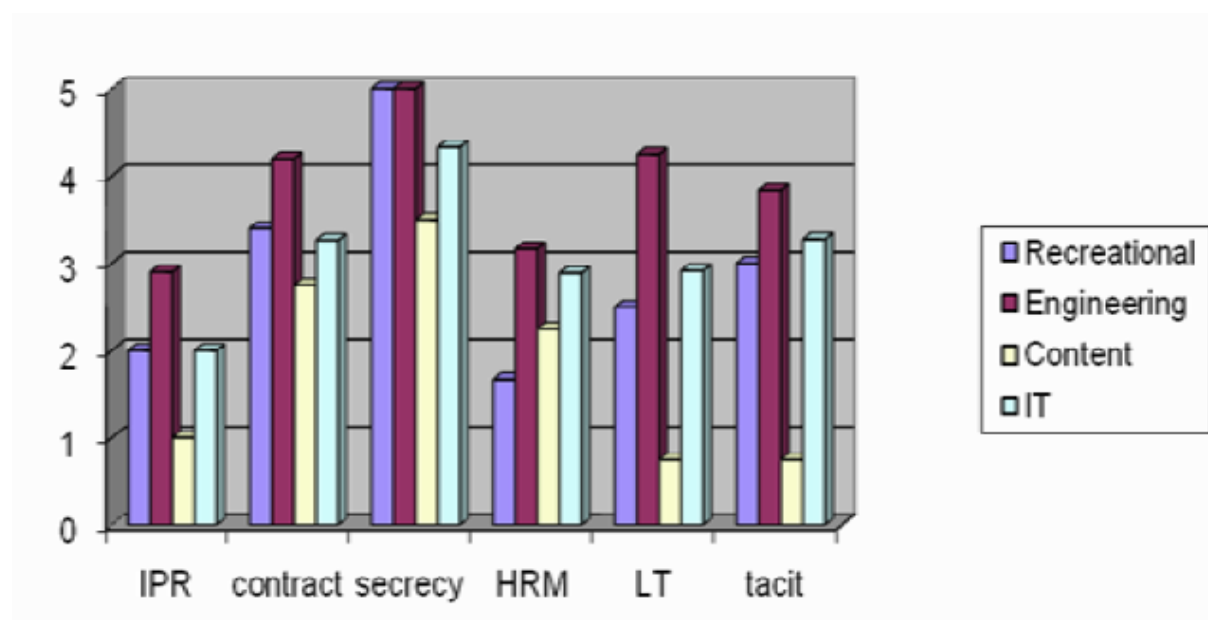


Figure 2-5 Relative importance knowledge protection mechanisms of SMEs (Olander, et al., 2009)

As can be seen in the Figure 2-5 above, is that formal/legal protection mechanisms (IPR) are perceived less valuable through SMEs. Also has to be mentioned that this research was a

multiple case study with 8 firms (2 of every type). So it is too early to talk about significant differences between different protection mechanisms, however there are some interesting differences between formal and informal protection mechanisms. The figure is in line with other literature about formal and informal protection mechanisms. However there must be stated that these publications often only research 2 different protection mechanisms as in Arundel (2001), or described a certain phenomenon Delerue & Lejeune (2010), Scheppele (1988), Olander, *et al.* (2011) or were not that recent anymore like in the case of Harabi (1995) and Mansfield (1986). This and taking into account that only 8 firms were used in the study of Olander no real conclusion can be drawn from the researches.

2.3.2.1 Lead time

Lead time can be an important knowledge protection mechanism, according to literature especially in fast changing environments (Amara, *et al.*, 2008). A more detailed description about lead time is stated in the previous chapter.

For SMEs is lead time most beneficial in a fast changing environment. In a rapid changing environment a firm can profit from lead time advantages for a certain time and come up with new innovations at the time the competitors imitate their behaviour. Or in markets where it takes the competitors some time to imitate the innovation (Leiponen & Byma, 2009). During this phase the firm has the opportunity to establish itself in the market and arrange a long lasting competitive advantage, even when competitors copied the innovation; but the consumers will remember the first mover and identifies the product with this firm (de Faria & Sofka, 2010) (Olander, *et al.*, 2009).

However Olander, *et al.* (2009) also states that lead time can be hard to reach for SMEs. In that perspective secrecy and human resource management (HRM) can be better mechanisms to protect the knowledge of SMEs. This is not confirmed by other literature who clearly states that the effectiveness highly depends on the business context of a firm (Gallié & Legros, 2012) (Delerue & Lejeune, 2010) (Hurmelinna-Laukkanen, 2009) (Levin, *et al.*, 1987).

2.3.2.2 Secrecy

In literature secrecy is the most research informal protection mechanisms (Arundel, 2001) (Harabi, 1995). According to Arundel (2001) secrecy is for SMEs one of the most important protection mechanisms; this was also one of the findings of Olander, *et al.* (2009).

A main advantage of secrecy is that it can already be used during the development phase of a certain innovation. (Hall, *et al.*, 2012). This cannot be achieved with formal protection mechanisms that are ex-post. It is generally stated that patents can be too costly for SMEs however this doesn't mean that informal protection mechanisms are cheaper. In order to maintain a good secrecy strategy good knowledge management is required which can also cost a substantial amount of money (Hall, *et al.*, 2012) (Arundel, 2001). For this reason some research aims for a combined usage of both secrecy and patents (Gallié & Legros, 2012).

2.3.2.3 Human resource management

When it comes to innovation in SMEs creative employees are the most valuable workers for a firm (Olander, *et al.*, 2011). Olander, *et al.* (2011) concludes in her research that in this case HRM is the most valuable and underestimated protection mechanism. When it comes to research most attention has been paid to secrecy over the years as an informal protection mechanism. However SMEs frequently lack HRM practices (Bacon & Hoque, 2005), there

are no practices as for recruitment, trainings and to conduct performance appraisals or develop policies on discipline and equal opportunities (Bacon & Hoque, 2005).

Where large firms are also often obliged to arrange these kind of facilities for employees (corporate governance), SMEs often fail to apply these kinds of practices, partly due to unawareness (Bacon & Hoque, 2005). However the research by Bacon & Hoque (2005) also states that firms with a higher degree of knowledge workers are more likely to adapt HRM practices, because knowledge is more valuable to them. Another important factor is the existence of a union, because they can bring knowledge and experiences to the SMEs.

2.4 Concluding remark

In this paragraph the chapter will be concluded with the development of the so-called theoretical framework. The theoretical framework is based on the literature study that is conducted during this research. The framework represents an insight in the specific links between the different theories in supply chain research. The connections between the different theories are illustrated in the theoretical framework.

Figure 2-6 presents the theoretical framework which links all the theory that has been described in this report. There are basically 4 different fields that influence the urgency for firms to protect knowledge.

As stated during the chapter to protect their knowledge SMEs rely most frequently on informal protection mechanisms. However this does not mean that SMEs do not use formal protection mechanisms at all. The usage of protection mechanisms highly depends on the environment and industry a firm is active in. The more competitive the environment is, the more likely is a firm to protect its knowledge.

As research states knowledge intensive firms rely more on knowledge protection mechanisms than not knowledge intensive firms. However most SMEs because of the higher costs for more informal protection mechanisms. Also the fact that SMEs serve more niche markets makes patents less applicable for them in general.

Firms however that develop products that can be codified and are perceiving a lot of competition will rely more on formal protection mechanisms as stated by literature. So the type of knowledge/innovation that needs to be protected is important. As stated in the literature firms that innovate in processes are perceiving informal protection methods as a better match.

It is also important to know that not all knowledge can be codified. In order to keep this knowledge for a firm informal protection mechanisms can be very useful.

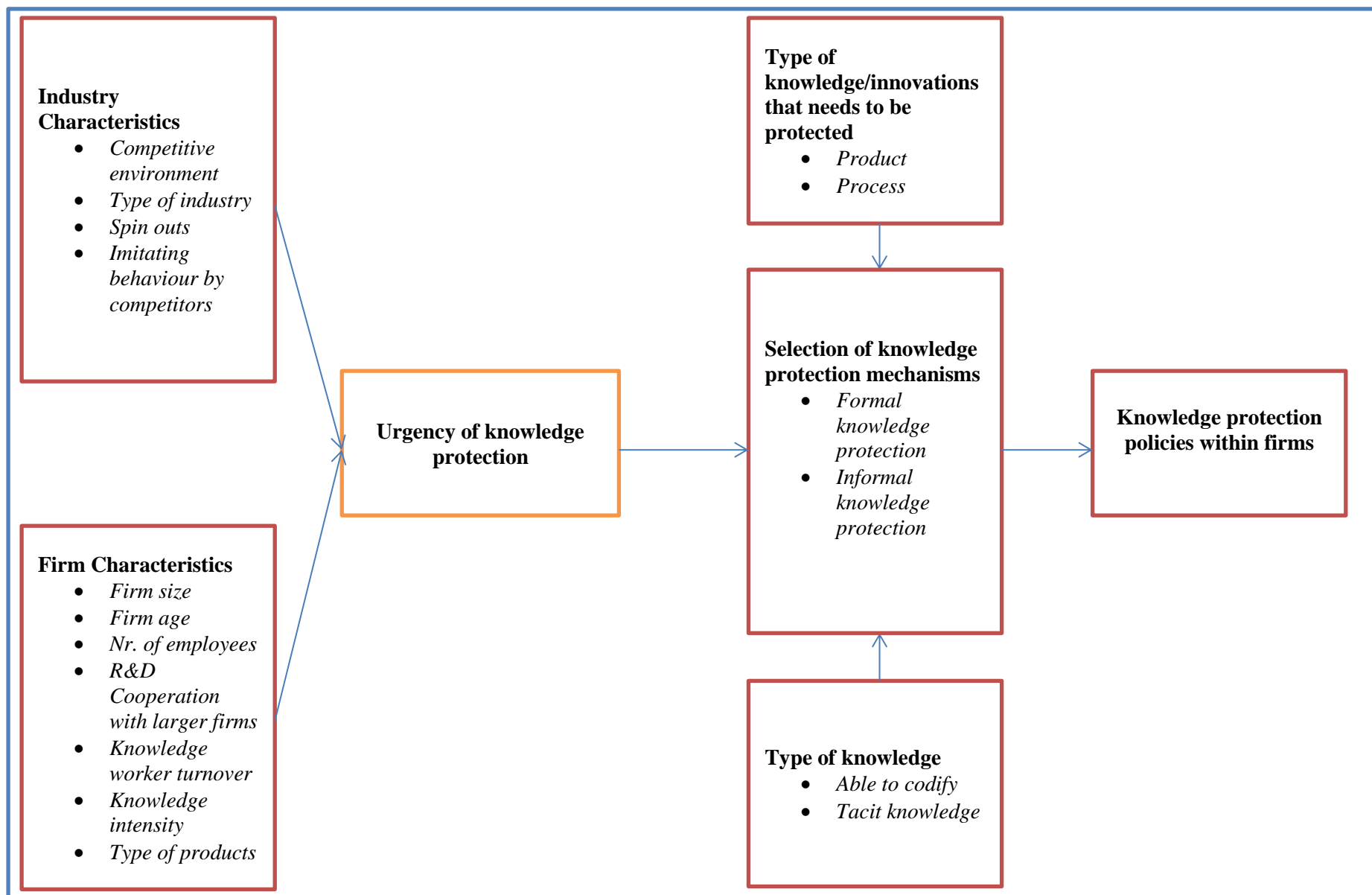


Figure 2-6 Theoretical framework

3 Methodology

In the previous chapter the theoretical framework has been explained, this theoretical framework will be the input of the methodology chapter. During this chapter the methodology that will be used during the research will be explained. The methodology chapter can be seen as a translation from the theory into a practical method in which the “real-life” can be measured and explained.

The main subjects of this chapter are the design of the research, data analysis, reliability, validity and limitations of the research.

3.1 Research Design

The first purpose of the research was to do a survey, however due to the difficulties in finding suitable firms and the low response rates on surveys. One of the main advantages of a survey is the fact that it has a broad scope. However in this research the scope isn't as broad as thought on beforehand. There are around 100 knowledge intensive firms that are selected for research. Another threat is the fact that during a survey it is not possible to go into deep about a certain subject because questions are standardised (Verschuren & Doorewaard, 2010).

Due to the above mentioned reasons it has been decided to change the research design of the thesis. In this design 15-20 firms will be interviewed (multiple case studies) and the other firms that are selected will be sent a questionnaire which they can fill in. With this approach a higher understanding can be achieved why firms select different protection mechanisms. A disadvantage is that the results cannot be generalised for the whole population because no statistical evidence can be proven (used population is too small).

3.1.1 Data collection

According to Verschuren & Doorewaard (2010) there are three main types of data that could be used to do empirical research; documents, media and people. O'Leary (2004) divides data collection methods in the following groups: observation, asking questions and content analysis (O'Leary, 2004). To stay in line with the report we will use the typology of Verschuren & Doorewaard (2010), for this research during the empirical part people will be used. During this part of the research an answer will be formed about the last two research questions. The people that are used are also called the objects of the research (Verschuren & Doorewaard, 2010). For this research individual people will be interviewed. Besides the selection of the objects, also a second questions needs to be answered and that is about what information is needed. According to Verschuren & Doorewaard (2010) there are roughly two types:

- Data (or facts)
- Knowledge

This research will rely more on data, for example data about the use of patents or other protection mechanisms, how useful to the objects perceive them and which variables play a role in the selection of the protection mechanisms.

As already been mentioned people will be selected as the research objects. These people will answer the questions asked in the questionnaire so they will act as respondents. The main advantages of these type of data collection is that it can be relatively quick and the information can have a broad range in which a clearer picture can be obtained of the problem (Verschuren & Doorewaard, 2010).

According to Verschuren & Doorewaard (2010), an interview can be about a subject that people find difficult to talk about. Or the research can deal with subjects people are not enough aware of to formulate a good opinion. These type of answers could lead to subjective answers on which it is impossible to formulate a good conclusion.

The data will be collected by a two-way approach. First as already described 15-20 firms will be interviewed about the way they protect knowledge/innovations. These interviews will have a semi-structured character, prior to the interviews an interview plan will be made and the interviews will be recorded. The other firms that are selected will first be called and asked for their collaboration for the research. With this calling prior before sending the questionnaire it is likely that the response rate will be higher (de Vaus, 2001). The questions asked in the questionnaire will be structured and closed so the firms can answer the questions in 5-10 minutes.

The firms are preselected according to a few conditions. These conditions are (1) a firm should be active in the agricultural business, (2) the firms should be a Small and Medium-Sized Company which means it has less than 250 employees (MKB Nederland, 2012). A third pre condition is the fact that the firm should be knowledge intensive. For this there are multiple reasons which will be discussed below.

There is not one exclusive method to measure knowledge intensity of firms or the closely related subjects as high- and low tech firms. Hall, Oppenheim & Sheen. (2000) first selected industries that were described as high-tech according to the literature; these were technology-based companies who were competing in a highly competitive market (Hall, et al., 2006). For this research this method is less applicable because this doesn't make a distinction between different firms and the industry is already selected.

More than two decades ago Mansfield (1986) and Jaffe (1986 & 1989) used the number of patents as a measure for innovativeness. Because are relatively easy to find because they need to be registered. A firms effort to patent also gives an indication about the value they attach to knowledge protection because patents are relatively expensive (Arundel, 2001). The propensity to patent can vary between industries (Wilcox King & Zeithaml, 2003) (Symeonidis, 1996).

In a research conducted in 2006, Thornhill used an existing database of Statistics Canada (Annual Survey of R&D in Canadian Industry (1999-2001) & Canadian Census (1996)). In order to divide the firms/industry he used two methods. The first method was the R&D intensity of the firms, which means the % of the turnover a company invests in R&D. This is complementary with the method used by OECD which uses a criterion of 3.3% (2005 average of European firms). The other method used by Thornhill was the % of knowledge workers in the high- and low technology firms. The percentage of knowledge workers in the

high technology firms was statistically higher than in low technology firms. A knowledge worker can be defined as followed:

“Knowledge workers have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge” (Davenport, 2005)

According to Davenport (2005), growth industries and (innovative) firms tend to have a high degree of knowledge workers.

Another method that is used are the numbers of significant innovations, a method that has been used by Amara, Landri & Traoré (2008) and is also mentioned by Symeonidis (1996). This method has as disadvantage that some innovations are more important than others and also it can underestimate continuous improvements made to existing products by the R&D department.

Less important are good predictors are firm size and market structure. Multiple studies have been done on this subject like Cohen *et al.* (1987), Cohen and Keppler (1994), Patil and Pavit (1992) as mentioned by Symeonidis (1996). This because multiple studies had also multiple outcomes and there was also no direct causal relationship with for example market structure and innovative efforts, knowledge intensity.

It has to be stated that all methods have their weaknesses, like bias, misunderstanding of the concept and perception (Block, et al., 2012). The most important selection methods as found in literature will be stated below:

- *Number of innovations*
- *% R&D expenditure*
- *% Knowledge workers*
- *Number of patents*

However because it is difficult to find the exact number of innovations, %R&D expenditures and the % of knowledge workers. It is even more difficult to find the prior the interviews with the firms. So the number of patents is selected as third criteria to select firms on. Because patents are relatively easy to find online (Espacenet, 2012) and can be done prior the interviews with firms so fewer questionnaires can be send out.

The interviews at the firms will be face-to-face. During this interviews are more detailed overview of the reasoning behind the selection of the protection mechanisms can obtained. Another main advantage is that it gives the opportunity to see the expression on the face of the interviewee and body language. A disadvantage is that it takes more time than for example online questionnaires.

The other questionnaires will be send online to the firms so the representatives of the firms can fill them in. An important thing that should be considered is the time issue. The questionnaire should not be too long otherwise the response rate will be lower. The firms will be called in advance. This will be done to higher up the response rate.

3.1.2 Data analysis

The data gathered through the interviews face-to-face and from the online questionnaire will be analysed. The data that is gathered is qualitative as well as quantitative. With this is meant that the online questionnaires are mostly filled with closed questions, these questions will also be asked during the face-to-face interviews however in these interviews the why question will be added. So the reasoning behind the selection mechanisms can be revealed and why do firms prefer some protection mechanisms above others.

The gathered information will be processed and analysed with Excel. This will include some basic statistics because the population is too small to do significance analysis etc.. However the analysis can give insights in the protection mechanisms firms prefer and the face-to-face interviews can give insights in the why questions, so why do firms prefer certain protection mechanisms.

3.1.3 Validity and Reliability

The reliability and validity in research is a very important issue. High reliability- and validity makes the data more trustworthy and therefore the results better (de Vaus, 2001). For this research a two typed approach is used (face-to-face interviews and an e-mail questionnaire). In this paragraph we first will deal with the different types of validity (construct, internal and external validity) and afterwards with the reliability of the research.

Construct validity: When a high validity is reached, the data collected should be able to reach the research his objective. A technique to do this is to build in a chain of evidence (de Vaus, 2001). This can be achieved by using multiple sources of data. This occurs in the phase where data is collected. During this research data will be gathered by face-to-face interviews and an online questionnaire.

Internal validity: In order to achieve a high internal validity explanation is very important (Verschuren & Doorewaard, 2010). In case of this research, one researcher will do the interviews so the data will be interpreted on the same way. For the online questionnaire it is really important that the questions are clear and are filled in correctly as it is meant to be. A very important subject is the letter attached to the questionnaire, this letter should be clear and brief so the interviewee knows exactly what is asked (de Vaus, 2001). To make sure the letter and the questionnaire will be as clear as possible; it will be checked by the supervisors of the research and afterwards by two specialists from the field, namely Hans Dons (BioSeeds BV) and Michiel van Galen (LEI). To improve the quality and the internal validity of the answers, the questionnaire and interviews will be carried out in Dutch so the understanding of the managers of the firms will be improved because their native language is Dutch.

External validity: With external validity is meant how the results can be generalized over a population (de Vaus, 2001). This can be difficult for this research because a small sample is taken from a larger population. As can be seen in subparagraph 3.1.1. the firms are preselected by a number of criteria. The criterion to select knowledge intensive firms was the number of patents. However this could mean that knowledge intensive firms without patents are excluded from the research. However by the use of multiple firms for the interviews and by carrying out an extra questionnaire a more general overview of how agricultural related

firms deal with knowledge spillovers should be achieved. Also are the firms from different agricultural field of expertise (mechanization, health, breeding, building etc.) so this should also help in order to give some statements about knowledge protection.

Reliability: With reliability is meant the fact that if the research will be redone the results would be the same (de Vaus, 2001). A risk for example is when only a small number of questionnaires are returned. This is the reasons why for this research a two stage approach is chosen with two types of data gathering. Also all firms will be called on beforehand to be asked for their cooperation. Also the online questionnaire will not take longer than 5 – 10 minutes so it can be filled in quick and not much specific data is needed from the firms. In order to improve the quality of the interviews and questionnaires it will be checked by the supervisors and two experts (Hans Dons and Michiel van Galen).

3.2 Limitations

During the research there will be factors that limit the research. They will be described during this paragraph. The most important limitations are; the available time, willingness to cooperate in this research and small sample size.

Because the research is a MSc thesis it means that it should be done in a specific amount of time. This time constraint has influenced the choice of the set up. In order to get significant results a large set up survey need to be carried out. However it has been chosen to do a 2-way questionnaire (face-to-face and online) in order to get good results with some in depth answers about why firms make certain decisions. So from the original purely quantitative analysis, it is now both quantitative as qualitative.

Another limitation is the number of firms that are found suitable for this research. Because a certain selection method is chosen (whether or not a firm has patents). This doesn't mean that the sample size includes all knowledge intensive firms because firms can also make the decision to not use patents but different protection mechanisms. So the results could be a little biased towards patents.

Due to the small sample size (approx. 100 firms), the willingness to cooperate in this research is very important. To ensure a good response rate every firm in the database will be called on beforehand and asked for their cooperation. This personal approach should improve the response rate of the research. Also due to the small sample size, no significant conclusion can be made.

4 Results

During chapter 4 the last two research questions will be answered. As stated in the previous chapter this will be done by face-to-face interviews and an online questionnaire. In total 17 face-to-face interviews has been carried out and the digital questionnaire has been send to approximately 70 firms.

The research questions that are going to be answered are as followed.

- Which protection mechanisms are perceived with the highest satisfaction by Dutch agro sector related SMEs?
- How does the Dutch agro related sector scores comparing with other industries?

In paragraph 4.1 the first of the two research questions will be answered and in paragraph 4.2 the 2nd research question will be answered.

4.1 Knowledge protection in Dutch Agro sector

In order to answer the research question 15 firms have been interviewed face-to-face and 70 digital interviews send to the other firms that didn't reject to cooperate after the firm was called and asked for their cooperation. 9 firms filled in the digital questionnaire, the firms that were interviewed face-to-face also filled in the questionnaire in order to make the answers comparable so in total 24 digital questionnaire were returned, so approximately 30% returned the questionnaire.

The characteristics of all the firms can be found in below in Table 4-1.

Table 4-1 Characteristics interviewed firms

| | Type of firm | Sector | Year founded | Nr. of employees | % R&D investment | Nr. of R&D employees |
|---|------------------|------------------------------------------|--------------|------------------|------------------|----------------------|
| A | Family firm | Milking parlours | 1934 | 200 | 3% | 18 |
| B | Subsidiary | Milk cooling systems | 1940 | 240 | 0.50% | 10 |
| C | Independent firm | Innovative dairy products, stable design | 1982 | 15 | 3% | 4 |
| D | Family firm | Stable design | 2001 | 6 | 3% | 1 |
| E | Family firm | Mechanization | 1915 | 150 | 3.50% | 18 |
| F | Subsidiary | Animal Health | 2009 | 2 | 2.50% | 2 |
| G | Independent firm | Stable design | 1990 | 3 | 2% | 1 |
| H | Independent firm | Manure storage systems | 1975 | 12 | 3% | 3 |
| I | Family firm | Stable design | 1973 | 45 | 5% | 10 |
| J | Independent firm | Mechanization | 1994 | 80 | 7.50% | 9 |
| K | Family firm | Mechanization | 1976 | 40 | 7.50% | 3 |
| L | Independent firm | Animal Health, stable design | 1994 | 15 | 1% | 2 |
| M | Independent firm | Mechanization | 2004 | 2 | 5% | 1 |
| N | Family firm | Mechanization | 1977 | 25 | 2.50% | 1.5 |
| O | Family firm | Mechanization | 1938 | 50 | 3% | 6 |
| P | Independent firm | Animal Health | 1995 | 50 | 5% | 15 |
| Q | Independent firm | Animal feed, animal health and breeding | 1971 | 45 | 15% | 4 |
| R | Independent firm | ICT | 1985 | 35 | 25% | 9 |
| S | Independent firm | Animal feed, crop production | 1991 | 12 | 2% | 8 |
| T | Family firm | Stable design | 1961 | 27 | 1% | 1.5 |
| U | Independent firm | Stable design | 1958 | 60 | 2% | 1 |
| V | Independent firm | ICT | 1986 | 93 | 4% | 12 |
| W | Independent firm | Stable design | 1970 | 8 | 2% | 1 |
| X | Independent firm | ICT | 1983 | 10 | 2% | 1 |

As can be seen in Table 4-1 a wide variety of firms has been used with ranging from 2 till 240 employees and with different age (ranging from 97 years till 3 years from existence).

There firms that only filled in where on average younger (on average the firms were founded in 1978 and the firms on which a face-to-face interview was conducted were founded in 1973), also the interviewed firms (firms on which a face-to-face interview was conducted) were larger (59 employees and the firms that filled in the questionnaire had on average 38 employees). However the firms that only filled in the questionnaire had a higher percentage of investment in R&D (percentage of turnover invested in R&D), these firms scored on average 6% and the interviewed firms 3%. However there were 2 firms who invested respectively 15% and 25% in R&D, when we leave them out of the overview the percentage would be 3%. The number of R&D employees was in both situation on average 6.

4.1.1 Innovation

Without any exception the firms indicated that innovating is extremely important in the aggressive competitive agricultural environment. This can also be seen in Figure 4-1 where the firms had to indicate the importance of innovations. The firms had to answer on a 9 point likert-scale and no answer was below 6 so every firm indicated that innovation was important, also 15 of the 24 firms answered with the highest answer possible.

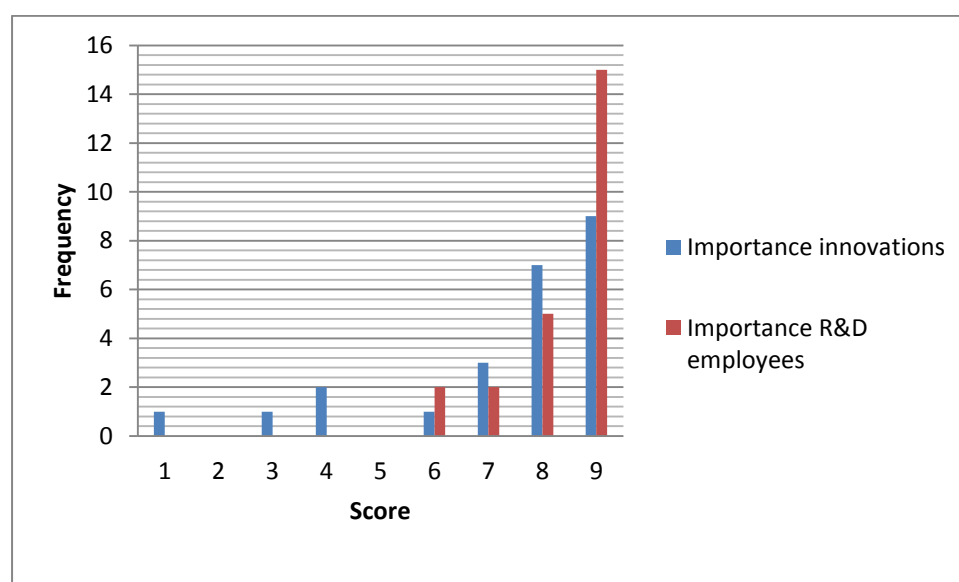


Figure 4-1 Importance of R&D employees and Innovations

All firms that were face-to-face interviewed indicated that innovating was the key to continue the firm (blue bar in Figure 4-1), without innovation the firms would lose market share or will even vanish from the market. The owners of firm C, D, G and M mentioned specific that innovating was their license to produce. These relative small firms focussing more on the “niche” markets. They were focussing on markets were for the larger players the volumes are to low according to the manager of firm G. This can also be seen on how important the firms value their R&D employees (red bar in Figure 4-1). The firms that attached lower values were the relative smaller firms, with in 3 cases 1 R&D employee and in 1 case 4 R&D employees. In the cases of 1 R&D employee the owner and manager was responsible for R&D.

As stated during the interviews the importance for innovation is due to the changing environment. As already has been stated in the literature research, the dairy sector can be described as innovative sector with many innovations. As stated during the interviews most

innovations focusses on increasing the dairy farmers productivity in order to achieve a good profit. Because at the moment the prices and margins are under pressure. Most firms came with 1 till 10 innovations over the last 5 years. This could also depend on the interpretation of the firm on innovations. Only four firms scored 10 innovations or more in the last 5 years, respectively 10, 10, 15 and 40 innovations. Two of these firms are active in stable building (developing floors etc.). The highest score is for a software specialist who continuously develops with new “products”, like management support adds, apps etc.. This firm also invests 25% of their turnover in R&D.

4.1.2 Competition

The firms mentioned that they face heavy competition in the markets they are active in. The damage this competition causes differs from firm to firm. During the face-to-face interviews all firms admitted that they perceive lots of competition on the Dutch market; this is also the reason why all the firms are also selling international directly or via dealers. In the questionnaire 4 questions were asked about competitors and competitions, below the results of the answers are presented in Figure 4-2.

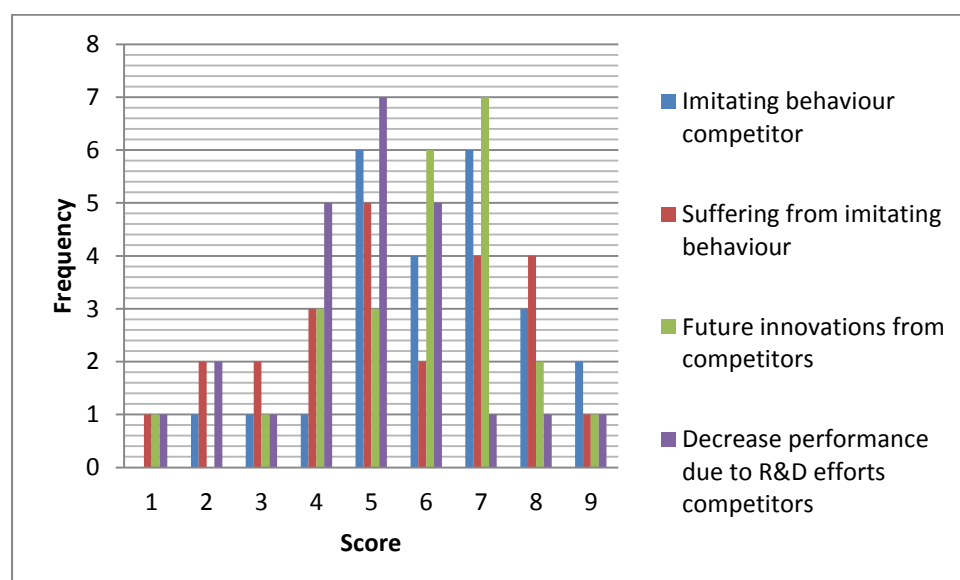


Figure 4-2 Suffer from imitating behaviour and R&D efforts from competitors

In Figure 4-2 the results are presented about how much do firms suffer from competition. The score which the firms gave on a Likert-scale is presented on the x-axis; the number of firms that gave a certain score are presented on the y-axis. The blue bar indicates how firms perceive that competitors are trying to imitate their innovations very often. The R&D manager of firm K indicated that they once set up their display at an exhibition, and once they left 5 representatives of a competitor took their photo camera and made pictures of the innovation for 1,5 hour. All the mechanization firms on which a face-to-face interview indicated that fairs and exhibitions are the place where competitors are looking at each other's products and look for innovative parts. So firms can suffer from imitating behaviour from their competitors, especially the mechanization firms and stable building/design indicated that due to strong competition they were suffering from the imitating behaviour of competitors as can be seen by the red bar in Figure 4-2.

However and that may be remarkable that firms on average indicate that they feel that their competitors are developing innovations that may have a negative effect on their firm (green bar) but they also indicate that they do not feel that their firm is performing not optimal due to R&D efforts (purple bar). During the interviews this has also been stated several times but the interviewees explained that a firm is always “scared” of possible new innovations of competitors however mostly firms are innovating in a certain way according to managing director of firm I (firms often focus on certain parts, for example hay machinery or harvesters. So the direction of the innovations is predictable). To keep the firm performing well a firm should keep innovating itself otherwise it will lose market share stated the managing director of firm O, being pro-active is very important.

4.1.3 Cooperation

As has been stated in chapter 2, SMEs often have the cooperate with other firms in order to carry out large R&D projects, develop new products and process or gain knowledge. From the firms who were interviewed not all firms had cooperation's. There were 6 firms who didn't have any cooperation with other firms. These were mainly smaller firms (ranging from 3 to 25 employees). All other firm did have some form of cooperation with other firms. In Figure 4-3 the average distribution of the cooperation is presented.

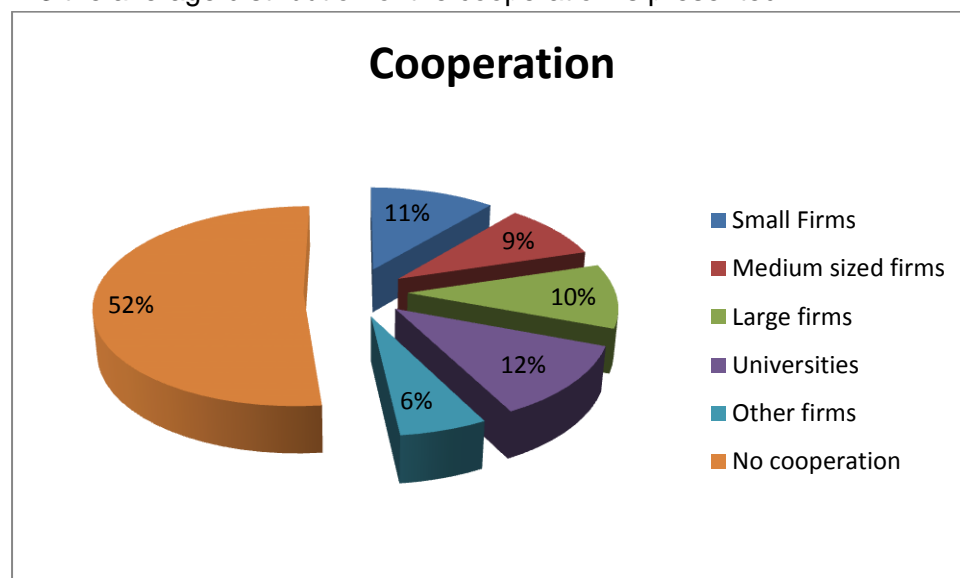


Figure 4-3 Percentage of cooperation with other firms

The firms had to answer a question about how much they cooperated with other firms like universities, other SMEs, large firms or other type of firms. The type of firm that was part of the cooperation depends largely on the type of research project a firm was in. For example for a new innovation this could be with a firm outside the sector because the sector that firm operated in already have experiences with certain techniques. As can be seen in Figure 4-3 the “average” firm did more than half of the R&D projects by themselves (52% no cooperation), the other 48% was mostly about cooperation with small, medium-sized, large firms or universities. However one thing was very strongly stated during the interviews, no firm cooperated in an innovation project with his or her competitor. The cooperation was always with a supplier, customer or business partner.

4.1.4 Employees

An important indicator of how successful knowledge protection is, is the turnover of employees and knowledge workers. All firms were asked to fill in questions about how many employees joined a competitor and how many employees started their own business in the same field (so they became a competitor of the former employer). In Table 4-2 the outcome is presented, on the left column the number of employees leaving the firm is presented. In the other columns the number of firms is presented.

Table 4-2 Frequency of spillover to competitor

| Formal employees (last 5 years) | | | | |
|----------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|
| | Firms that lost employees to competitor | | Firms that lost employees because of starting up own firm | |
| Number of Employees leaving a firm | Nr. Of firms were Employees joined competitor | Nr. Of firms were R&D Staff joined competitor | Nr. Of firms were Employees started their own firm | Nr. Of firms were R&D Staff started their own firm |
| 0 | 14 | 19 | 17 | 20 |
| 1 | 6 | 4 | 2 | 2 |
| 2 | 1 | | 3 | 1 |
| 3 | 0 | | | |
| 4 | 0 | 1 | 1 | |
| 5 | 1 | | | 1 |
| 6 | | | | |
| 7 | | | | |
| 8 | | | 1 | |

As can be seen in Table 4-2 6 firms lost 1 employee the last 5 years to a competitor and 4 of those 6 employees were part of the R&D staff. Furthermore 2 firms lost 1 employee because he started his own firm (both were part of the R&D staff).

These numbers are not really high, according to the interviewees there were several causes for this. The first and maybe the most important is HRM (we will come back to that later during this chapter). A second reason is the geographical distance between competitors. In most cases the interviewees explained that the competitor was simple too far away, so the employees had to move if they didn't like a long journey which takes a lot of time. So moving to a competitor was a practical problem.

The reason why not many employees started their own firm was because the starting costs where a barrier that scares off most employees to start their own firm; as stated by the managing director of firm O, also the managers of firm A, B, E, H & K mentioned this specific during the interviews. So due to the high costs these former employees were not able to create the same things as their former employer did with the same quality or same costs. In some cases where the employee started his own firm he became for example dealer for a mechanization firm so he was acting in the same field but not a competitor but a customer of the former employer.

4.1.5 Knowledge protection

During the interviews all firms indicated that they tried to protect their knowledge with one or more of the mechanisms that are mentioned in chapter 2. At the end of the questionnaire the firms had to answer a question about which knowledge protection mechanisms they are using and how much knowledge they protect with it (firms should divide 100% over the different protection mechanisms). Because not all firms filled in the form correctly, so only 19 of the filled question forms are used for this overview. In Figure 4-4 an overview of the average usage of the protection mechanisms is presented.

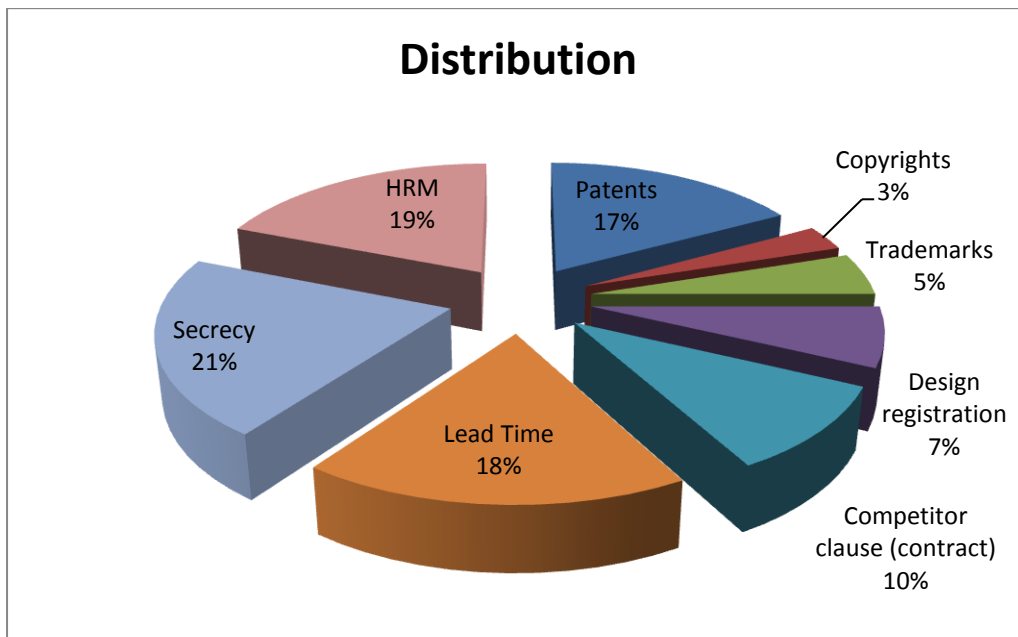


Figure 4-4 Average usage of knowledge protection mechanisms

As can be seen in Figure 4-4 from the formal protection mechanisms patents is the most important one with a share of 17% and competitor clause scores 10%. As already has been stated in literature trademarks and design registration are less used and perceived less valuable. From the informal protection mechanisms all three have high scores with Secrecy as being valued most important with 21%. The results are comparable with the results of the literature research. All protection mechanisms will be discussed separately in the next paragraphs.

4.1.5.1 Patents

Patents are still often used in agriculture; this can be seen in Figure 4-4. However there is also a declining tendency in the use of patents and the number of patent applications under the interviewed firms. All interviewed firms used patents ranging from 1 to 35 patents. However multiple firms indicated that they were not going to apply for more patents or that they were applying less for patents. The R&D manager of firm E stated that in the past there was a tendency that agricultural firms tried to put as much on paper as possible so most innovations were patented. This statement was confirmed during interviews with other firms. However the last few years due to multiple reasons firms are patenting less or not even patent anymore.

Only one firm (firm G) indicated that patents were for his firm extremely important and he was using a slightly different approach than other firms. In his opinion he was not patenting products but concepts. This firm designed a concept which consisted of multiple patents. So when a firm also wanted to use and sell this concept he was violating multiple patents. The manager designed it in this manner because of bad experiences when only a certain product was patented. In this case he said it is for the violator of the patent relatively easy to get around the patent or to challenge the patent in front of the court.

The rest of the firms on which a face-to-face interview was conducted all had patents. There were five firms (firm A, C E, G & M) who indicated they still from time to time apply for a patent. The other firms did not applied in recent years for patents and only two were thinking of applying in the future for a patent again, but only for revolutionary innovations. The main reasons why firms patent less or not at all anymore are various, however in most interviews the firms gave the same reasons.

- Costs of patents
 - Cost of getting patent approved
 - Cost per country per year (maintaining the patent)
 - Cost when patent is challenged in front of court
 - Cost of monitoring
- (Too) Easy to get patent
- Not dynamic
- Bad experience in the past
- Different patent legislation in countries (not every country is as consequent as should be)

One of the most important of the most important reasons for not applying or less applying for patents is the costs of the patents. The costs of applying and maintaining a patent can be too expensive for firms. Also the fact that for a patent every year for every country a certain fee needs to be paid can be too expensive. Another problem can be monitoring, with this problem firms were struggling a lot. A few firms tried to monitor via their dealers in certain countries and also only applied for patents in countries they were active in. Other firms mainly rely on what they see on exhibitions and fairs. The agro technology firms (mechanization and stable design) were all member of the agro technology association (Federatie Agrotechniek) which publishes every month a list with new patents that are relevant for the firms.

Almost all the firms also stated that it is nowadays relative easy to apply for a patent and to get a patent granted. However afterwards for example the patent is challenged on court it can be that the patent is stripped and not as good as it was anymore or even worse declared invalid. Also the costs for a good patent advocate are high, according to the manager of firm O the advocates cost approximately € 500, - per hour, and below € 350, - you will not find a decent advocate.

Another reason for not applying for patents is that patents are rather static and in a fast moving market were product innovations and improvements follow each other up rapidly

patents are less valuable. Because the time when a patent is up-to-date and used is too short which makes it too expensive.

A few firms applied for less or no patents at all due to bad experiences with patents. For some firms this was the case when they decided to challenge a patent or when they think a competitor imitates a patented product of the firm. However the outcomes were often disappointing so the firms are not likely to apply for many patents again due to this experience.

The last reason named during the interviews was the different legislation in Europe and for example North America. According to the managing director of firm O in Europe has the person who applies for the patent the protection and in North America the person who invents it. Also the differences between how consequent the legislation system is, is according to the manager of firm C an important reason to apply for patents in certain countries and in certain countries not. He had some bad experiences with southern European countries and how consequent they were in their legislation system.

4.1.5.2 Design registration

Design registration wasn't a valuable protection mechanism for most firms. However there were a few firms who were actively using design registration. Design registration is important for firms who are active in stable building and making other (physical) innovative devices that can be used for the dairy farmers; the strength of these devices and materials are the way they are constructed and look and this can be protected with design registration. Besides that the cost for design registration are not that expensive in comparison with for example patents. This was also a reason for firms to apply for this type of knowledge protection.

However design registration was for many firms not that important due to the fact that a competitor could easily change the design (when the look is not that important) and make more or less the same product with the same product specifications.

4.1.5.3 Trademarks

No firm on which the face-to-face interviews were conducted stated that trademarks were important protection mechanisms. As stated in chapter 2 a trademark gives the owner the right to exploit the logo and name of the firm. However for the firms in the interviews this wasn't an important protection mechanism because it doesn't protect the firm from imitating behaviour.

4.1.5.4 Copyrights

Copyrights were valued as least important for the firms, there were only three firms that filled in the digital questionnaire that state them as "important" and were using it. Only the firms that are making software stated them as valuable, this because no patent can be applied on software and so copyrights give their products protection (Agentschap NL, 2012).

4.1.5.5 Competitor clause (contract)

Most firms were using a competitor clause in the contracts of their employees. This clause is intended to prohibit the (former) employees to work for a competitor or start their own firm for a certain manner of time. When an employee does he has to pay a fine.

Most firms gave contracts between 5% and 20% of the usage to protect knowledge. During the interviews the firms mostly stated that employees have a standard clause. However most representatives of the firms questioned the strength of such a contract. The managing director of firm I stated that when an employee is focussed to leave the firm he will leave anyway, this was confirmed by other firms. However it also needs to be mentioned that not many firms were facing that employees were leaving the firm for a competitor or started their own firms. This was also mainly caused by the geographical barricade which means that both firms are not in the same area. When the employee wants to leave for a competitor he needs to move and most people are bound to certain places. Also the costs of starting their own firm were too high for an individual was often stated.

4.1.5.6 Lead time

With 18% lead time is stated to be an important knowledge protection mechanism. However it was also the protection mechanisms who received the widest range of scores from 0% till 50%.

It was remarkable that the firms who stated lead time as very important didn't use frequently patents (because of high costs, for an overview see 4.1.5.1). One of the firms that valued lead time specifically as very important was firm I. Due to bad experiences with patents and a fast moving market he stated that lead time was the most important protection mechanism for their knowledge and innovations. The lead time advantage was indicated as very important by the firms when an innovation was introduced. The firms who indicated that lead time was important also estimated that it takes at least 6 months to a year for competitors to imitate a product or to gain the knowledge.

This advantage gives the firm the time to build up a reputation and to continue product development so they maintain their advantage over time. As already stated firm I was using lead time often. This firm made in the past the choice to make no longer use of patents and focus on lead time and is satisfied with the results. The firm also stated that it was important to make sure that competitors need a certain time to imitate their innovation/knowledge. An example of a measure that can be taken is to make sure that the product chain is complex. So that people working on the product only make small parts of the product. This is especially important in case of cooperation with other firms.

4.1.5.7 Secrecy

The firms who were selected all indicated that secrecy is the most important protection mechanisms. This is in line with the literature as can be read in chapter 2. Especially during the development phase of innovations secrecy is perceived as very important. Because an innovation cannot be put on paper (formal knowledge protection) before it is finished (or at least the concept is finished), till then secrecy was the most important protection mechanisms.

After the innovation process firms made a choice whether they would go for a patent or will go for lead time. When a firm did go for a patent the role of secrecy was over. However when a firm chose to go for lead time protection secrecy could still be very valuable in order to delay the process of the competitor to imitate the product/process. Especially the firms who were active in fast changing markets found secrecy very important. Firms who are active in less changing markets valued patents higher due to the long-term protection over

secrecy. They stated as disadvantage that once a secret is discovered the advantage is gone. During cooperation's with other firms in most cases a secrecy statement was signed by all parties in order to keep the project a secret. When it is proved that a firm who was part of this statement broke it, it has to pay a large fine as compensation. However due to the mutual benefits of such a cooperation, no firm experienced that another firm broke the statement.

4.1.5.8 Human Resource Management

In chapter 2 has been stated that HRM (Human Resource Management) is one of the most underestimated protection mechanisms. This was confirmed in the face-to-face interviews. Were firms stated that their (R&D) employees were crucial in the innovation process and that their knowledge should be remained for the firm.

The importance of the knowledge workers (R&D employees) was also underlined by the answer the firm gave to the question how much of the knowledge can be written down on paper. In Table 4-3 an overview of the answers of the respondents is given.

Table 4-3 Knowledge that can be codified

| Percentage | 0-25% | 26-50% | 51-75% | 76-100% |
|------------|-------|--------|--------|---------|
| Frequency | 1 | 6 | 11 | 6 |

As can be seen only 6 firms indicate that 76%-100% of all knowledge can be codified. On average the firms indicate that 66% of the knowledge can be codified and three firms state that 95% or more can be put on paper. During the face-to-face interviews the firms indicate that current innovations can be written down on paper and also the knowledge that is incorporated with that innovation. However the knowledge to develop new products and or processes is embedded in the employees and it takes years to develop such skills. This is also why firms indicate why they make efforts to remain these knowledge workers for the firm. All firms mentioned the aspect of given the employees the space to develop themselves in order to come up with creative solutions.

Besides the experience the firms indicated that the costs of hiring, training and replacing certain employees were very high. This also forces the firm to remain the valuable employees for the firm. This is also in line with the theory presented in chapter 2.

Given the low number of employees who started their own firm or joined a competitor indicates that most firms performed well on this part. A remark has to be made that some the employees who stopped working at a firm and changed to another sector didn't were taken into account in the questionnaire.

4.1.6 Concluding remark

During the paragraph the following research question is answered:

- Which protection mechanisms are perceived with the highest satisfaction by Dutch agro sector related SMEs?

In general there is a tendency that firm values the informal protection mechanisms more important than the formal protection mechanisms. The choice of the protection mechanisms

depends highly on the competition the firm is facing, the behaviour of the markets and the preference of the firms itself. However it can be said that from the formal protection mechanisms patents and contracts are most used. In the case of contracts it is often a standard procedure and firms doubt the strengths of contracts when for example they are challenged in front of court. With patents it highly depends on the firms, however most firms indicate that they are using fewer patents as in the past due multiple reasons. One of the most important reasons is costs. These costs are increased due to the relative small size of the Netherlands firms need to apply for patents in more countries which increases the costs. Design registration is only perceived valuable for firms by which the appearance of the product is important, for example with stalls and feeding fences. The other formal protection mechanisms (trademarks, copyrights) are perceived not valuable because they do not offer proper protection according to the firms.

Informal protection mechanisms are perceived as very important. Secrecy is valued most used and also important especially during the development phase secrecy is frequently used. And after developing it is still used often in combination with lead time in order to delay the imitation process of the competitor. Lead time was also stated as important, this because most firms were facing a fast moving environment with lots of innovations. In such an environment lead time is more valuable according to the firms then patents and lead time gives the innovator enough time to exploit and develop its innovations in order to maintain a competitive advantage. The third important informal protection mechanisms is HRM, this is indicated as important because not all knowledge can be written down on paper, especially not the knowledge which leads to future innovations. Besides that the costs of replacing, hiring and training new employees is also very high and the potential damage which can be caused to the firm is also high.

There can be concluded that informal protection mechanisms are perceived better by the firms that are interviewed. However the selection of the best, or combination of the best protection mechanisms depends on the preference of the firm, the environment and competition.

4.2 Plant breeding sector

The last research question is about comparing the Dutch dairy sector with another sector. The research question is stated below:

- How does the Dutch agro related sector scores comparing with other industries?

It has been chosen to compare the dairy industry with the plant breeding sector, because literature has shown that this sector is also very innovative and is also facing some knowledge protection problems (Louwaars, et al., 2009). In order to answer the research question two face-to-face interviews (firm Y & Z) has been conducted and two important reports about this phenomenon have been studied.

“Plant breeding is the basis for propagation material in agriculture and horticulture and creates the plant varieties that form the cradle of continuous yield increase of crops, thus making an important contribution to food security. Plant breeding also contributes to sustainability” (Louwaars, et al., 2009).

As can be read in the statement above, plant breeding is worldwide an important sector. Like the dairy sector in the Netherlands, the plant breeding sector in the Netherlands is rated as one of the top 3 countries in export value worldwide (Louwaars, et al., 2009). In comparison with the Dutch dairy sector where a lot of SMEs are operative; the plant breeding sector is dominated by a few large firms (Winnink, 2012). This was also indicated by the managers of firm Y and Z. The turnover of seeds is € 2.5 billion (Louwaars, et al., 2009) and the industry employs approximately 10.000 workers.

In general can be stated that the cycle from research till the product is sold can be very long in plant breeding. Because of this lengthy and costly process the top firms invest between 15- and 25% of their annual turnover in R&D; and this level keeps track with the increase in turnover (Louwaars, et al., 2009). According to Louwaars, et al. (2009) was in the past plant breeding mainly an empirical activity where breeders on the basis of knowledge and experience selected the plants. The breeders however were depended on weather, space etc.. During this time the development period was 10-24 years. However this decreased the last 30 years to 4-11 years due to DNA technologies, molecular breeding, etc.. The manager of firm Y indicated that for potatoes the cycle is about 11 years before the “new breed” is ready for the market, and then it will take a few years to get enough volume. So the demand planning needs to be made 15 years in advance.

The decrease in the development period was initiated in the 1980's as a result of the application of biotechnologies. These technological drivers and globalisation can be seen the main factors behind the increasing concentration of firms (Winnink, 2012) (Louwaars, et al., 2009).

Due to the large investments that need to be made in order to develop new breeds firms want to protect their breeds in order to profit from their R&D efforts. In contrast with the dairy sector, the plant breeding sector has its own system, the so-called breeder rights. These breeder rights are one of the oldest protection mechanisms and also one of the most important according to the managers from firm Y and Z and also according to Louwaars, et al. (2009). According to the interviews and literature there is one more very important protection mechanisms which use is increased over the last decade, namely patents (Winnink, 2012).

As already has been stated plant breeders rights (PBR) and patents are the most important and used systems in plant breeding. They have as a comparison that they both offer protection for the issuer. It also gives that the developer is recognised for his development/creation/innovation by granting him or her the rights (Louwaars, et al., 2009). According to Louwaars, et al. (2009) patents as well as PBR “serve an important socio-economic objective namely the disclosure of information in a patent and by making a plant variety under a PBR available for further breeding (breeders exemption). This offers possibilities to build on such inventions and may stimulate further innovation by others, including competitors, with serves the public objective of economic development.”

However this is not the case the plant breeding sector. According to literature and the managers of firm Y and Z the use of both patents and breeders rights creates a monopoly position for some firms and discourages competition. Due to the entrance of biotechnology

firms in the 1980's much research has been invested in molecular breeding, genomics etc.. This extremely raised the costs of R&D which did not improve the competition and also raised the entry barriers for new firms. The introduction of the patent system in the plant breeding also concentrated the competition even more. Other systems like trademarks and PBR can simply be used by small firms, however patents are very costly (Winnink, 2012) (Louwaars, et al., 2009). This was also confirmed by the manager of firm Y who stated that patents is too much work and maintaining them is too costly. This was the reason why his firm did not apply for patents anymore. Besides the work challenging a patent can be very costly for small firms and also applying for patents can be too costly for SMEs, which creates a situation where large firms can make strategic use of patents to drive the small parties out of competition (Louwaars, et al., 2009). This again concentrates the competition even more.

The manager of firm Y also indicated his fear when genetic modification will be allowed in Europe. When this is allowed firms can integrate certain patents which they had patented in the plants and then sell the breeds, this leaves less space for competition. When this is happening the manager indicated that his firm has no choice and also needs to get patents. He and the manager of firm Z also concluded that the patents are not improving innovation but putting an hold on innovation because only a few firms now stay active in the plant breeding and innovations becomes too costly for other firms. So the open innovation systems that marked the plant breeding in the past is now turned around.

The plant breeding sector is differing in many ways from the Dutch dairy sector. In the Dutch dairy sector a lot of SMEs are active and there is a trend of using more informal protection mechanisms instead of formal protection mechanisms that are more and more used in the plant breeding sector. So besides the monopolistic position in the plant breeding sector of certain firms in the Dutch dairy sector the competition is much more diverse and less dominated by a few firms. However the levels of average R&D investments are also much lower in the Dutch dairy sector (most firms score between 2 and 5%, in plant breeding between 15- and 25%). So at first people may say that the dairy sector is less innovative than the plant breeding sector however when we look towards the future, the future of the dairy sector looks more promising when it comes to innovation. Because the patenting behaviour of the dominant firms in the plant breeding will as it is expected but the brakes on innovation.

Discussion & Conclusion

The discussion and conclusion is the subject for this chapter, during the discussion a critical analysis of the results will be written down and suggestions for further research. During the conclusion the general research question will be answered.

Discussion

During the discussion a critical analysis will be made about the research and the results. So how the results should be interpreted. As already has been stated not many research has been done about the negative effects of knowledge spillovers. Most research till today has focussed on the positive effects of knowledge protection for the economy. Within the scarce research that has been done the research mostly focussing on large firms and underestimating the influence of SMEs. In agriculture there has been no research as far as known about the (negative) effects of knowledge spillovers. The negative effects can be dramatic for innovative firms/sectors; the Dutch agriculture is an innovative sector in which firms try to achieve a competitive advantage by innovating. So the aim of this research was to contribute to the knowledge of which knowledge protection strategies should be used by entrepreneurs to protect their valuable knowledge. In order to answer this question firms that are operative in this field were interviewed face-to-face in order to get a detailed overview of the strong and weak points of certain protection mechanisms.

In order to answer the general research question and to fulfil the research objective a literature study has been carried out in chapter 2. Besides the limited amount of theory about the Dutch agricultural sector, and the literature that was available was mostly about primary firms or about the agriculture/agro sector in general. The first idea was to carry out a large scale survey among Dutch knowledge intensive agricultural (related to dairy) SMEs. However this was not achievable during this time period and because no data base exists with knowledge intensive agricultural firms. So the firms had to be selected firm by firm. This was done by using the site of the chamber of commerce and the European patent database. Where was checked if the firms had any patent applications. Because the firms were selected on patent application could mean that the firms on which the interviews were conducted are more positive about patents then the entire population of knowledge intensive firms. However during the interviews could be seen that not all firms were positive anymore about patents and the results can be compared with the results of for example the research of Olander, et al. (2009) about SMEs.

A thought was to do a large scale survey under Dutch agricultural SMEs. However this was difficult to achieve because there was no database with knowledge intensive SMEs. The database should be large due to the in general low response rates of surveys. So in order to get enough data it has been decided to do at least 15 face-to-face interviews with firms and the other firms in the database should be send the questionnaire. All firms were called in advance; only one firm told on the telephone that they not wish to cooperate. The other firms mostly stated that they want an e-mail with more information so they could make a decision. After the call and e-mail only 9 firms responded and filled in the online questionnaire. From the firms on which a face-to-face interview was conducted with 10 firms a direct appointment was made and in case of 5 firms an appointment was made during an e-mail session. For

the last sub question 2 persons from SMEs were interviewed and two recent studies were used that addressed the problems with knowledge protection in the plant breeding.

Due to the face-to-face interviews a good overview about the knowledge protection mechanisms was created. However due to the small sample size no significant results could be created and nothing could be said about the differences in subsector for example mechanization firms rely more on patents then animal health firms. However this research was as far as could be seen during the literature study the first on this topic in agriculture so perhaps in the future this topic could be more explored and statements can be made about which type of firms uses certain types of knowledge protection.

Conclusion

During the conclusion an answer will be formulated on the main research question which is stated below.

How can Dutch agro sector related SMEs protect themselves against the negative externalities of knowledge spillovers by using protection mechanisms?

As already been stated in the first chapter the general research question focusses on the best knowledge protection mechanisms for agro related firms. However as already could be read in the report the choice of knowledge protection mechanisms depends highly on the preferences of the firm, characteristics of the firm and the competition. So the assumption has been made that the most used knowledge protection mechanisms are also the most effective protection mechanisms because they meet the demands of the firms. For this research it is assumed that entrepreneurs and managers choose the protection mechanisms in which they trade off costs and benefits. So the entrepreneurs/managers would choose the most effective and efficient knowledge protection mechanisms that would fit their firm.

The Dutch agro sector related SMEs can protect their knowledge and innovations with the use of knowledge protection mechanisms. There are roughly two different types of knowledge protection as has been stated in chapter two, namely formal- and informal protection mechanisms. The category formal protection mechanisms contain; patents, trademarks, copyrights, design registration and contracts. The informal protection mechanisms included in this research are secrecy, lead time and human resource management (HRM).

These protection mechanisms are designed to help firms protect their valuable knowledge, because once a firm is innovating this process costs lots of money and after the innovations is ready for the market the firms would like to benefit from this. In order to benefit from this firms need to protect their knowledge otherwise competitors can copy the innovation or knowledge and also benefit from the efforts the innovating firms made. However the competitor didn't invest the same amount of money in the development as the innovating firm did. So there is a need for knowledge protection.

All forms of knowledge protection have their strengths and weaknesses. The formal protection mechanisms offer legal protection, however most of them can only be applied when the product is finished and not during the development phase. Besides these reason, they are also expensive, especially patents.

As can be seen in the results there are many differences between firms however there seems to be a tendency for informal protection mechanisms. Only one firm was using patents still heavily and tries to create a situation where a firm tries to copy an innovation he infringes multiple patents. Other firms only make use of patents from time to time in case of exceptional innovations with lots of potential for multiple years. However the firms indicated that they were operative in a fast moving environment didn't use patents any more due to high cost and the time the patent is relevant is very limited. In their opinion there are cheaper mechanisms that also do good work for example as lead time or secrecy. Also the fact that multiple firms indicated that the Netherlands is a small country in which not enough volume can be achieved so the firms need to sell their product outside the Netherlands which makes it difficult and expensive to protect knowledge with formal protection mechanisms.

The fact that firms need to protect was clear because the effects could be dramatic. The firms all indicated that there was a need to protect. However they also indicated that not all knowledge could be codified so this would also aim for the use of informal protection mechanisms. However none of the firms had the idea that the firm was damaged by employees who joined the competitor because that didn't happen frequently. So that knowledge did went to the competitor due to geographical restrictions.

So in general can be concluded that there is a trend towards informal protection mechanisms because of costs, they are more dynamic etc. however, the choice mainly depends on what the firm wants, what is the potential of the innovation/knowledge and the environment the firm is active in.

Bibliography

- Acs, Z., Braunerhjelm, P., Audretsch, D. & Carlsson, B., 2009. The knowledge spillover theory of entrepreneurship. *Small Business Economics*, pp. 15-30.
- Agentschap NL, 2012. *octrooicentrum.nl*. [Online]
Available at: <http://www.agentschapnl.nl/onderwerp/hoekuntuwideebeschermen>
[Geopend 26 April 2012].
- Amara, N., Landry, R. & Traoré, N., 2008. Managing the protection of innovations in knowledge-intensive business services. *Research Policy*, pp. 1530-1547.
- Arundel, A., 2001. The relative effectiveness of patents and secrecy for appropriation. *Research Policy*, pp. 611-624.
- Arundel, A. & Steinmueller, E., 1998. The Use of Patent Databases by European Small and Medium-sized Enterprises. *Technology Analysis & Strategic Management*, pp. 157-173.
- Atkins, M., 1998. The role of appropriability in sustaining competitive advantage - an electronic auction system case study. *Journal of Strategic Information Systems*, Volume 7, pp. 131-152.
- Audretsch, D., 2002. The Dynamic Role of Small Firms: Evidence from the U.S.. *Small Business Economics*, pp. 13-40.
- Bacon, N. & Hoque, K., 2005. HRM in the SME sector: valuable employees and coercive networks. *International Journal of Human Resource Management*, 16(1), pp. 1976-1999.
- Bader, M., 2007. Extending legal protection strategies to the service innovations area: Review and analysis. *World Patent Information*, Volume 29, pp. 122-135.
- Blind, K., Edler, J., Frietsch, R. & Schmoch, U., 2006. Motives to patent: Empirical evidence from Germany. *Research Policy*, Volume 35, pp. 655-672.
- Block, J., Thurik, R. & Zhou, H., 2012. What turns Knowledge into Innovative Products? The Role of Entrepreneurship and Knowledge Spillovers. *Journal of Evolutionary Economics*, p. 24.
- Blomqvist, K., 2002. *Partnering in the dynamic environment: the role of trust in asymmetric technology partnership formation*, Doctoral Thesis. Lappeenranta: Acta Universitatis Lappeenrantaensis 122.
- Blomqvist, K., Hurmelinna, P. & Seppänen, R., 2005. Playing the collaboration game right-balancing trust and contracting. *Technovation*, pp. 497-504.
- Bowen, D. & Ostroff, C., 2004. Understanding HRM-Firm performance linkages: The role of the "strength" of the HRM system. *Academy of Management Review*, 29(2), pp. 203-221.
- Cassiman, B., Pérez-Castrillo, D. & Veugelers, R., 2002. Endogenizing know-how flows through the nature of R&D investments. *International Journal of Industrial Organization*, Volume 20, pp. 775-799.
- CBS, 2012. *Landbouw; economische omvang naar omvangsklasse, bedrijfstype*. [Online]
Available at: www.statline.cbs.nl
- Chyi, Y.-L., Lai, Y.-M. & Liu, W.-H., 2012. Knowledge spillovers and firm performance in the high-technology industrial cluster. *Research Policy*, pp. 556-564.
- Cohen, W. & Walsh, J., 2001. R&D information flows, appropriability and R&D intensity. *NIST Special Publication*, Issue Papers and Proceedings of the Advanced Technology Program's International Conferences on the Economic Evaluation of Technological Change, pp. 22-29.
- Commissariaat voor Buitenlandse Investeringsen , 2001. *Innovatie en inkomende investeringen*, The Hague: Ministerie van Economische Zaken.
- Dahlgaard, S. & Dahlgaard, J. J., 2003. Towards a holistic understanding of human motivation: core values-the entrance to people's commitment. *AI & Society*, pp. 150-180.

- Davenport, T., 2005. *Thinking for a Living*, Boston, Massachusetts: Harvard Business School Press.
- De Arbeidsrechter, 2012. *De Arbeidsrechter*. [Online]
Available at: <http://www.arbeidsrechter.nl/concurrentiebeding-in-de-arbeidsovereenkomst-bl>
[Geopend 5 April 2012].
- de Faria, P. & Sofka, W., 2010. Knowledge protection strategies of multinational firms-A cross-country comparison. *Research Policy*, pp. 956-968.
- de Jong, J., 2006. *Meer Open Innovatie - Praktijk, ontwikkelingen, motieven en knelpunten in het MKB*, Rijswijk: EIM .
- de Vaus, D., 2001. *Research Design in Social Research*. London: SAGE Publications.
- Delerue, H. & Lejeune, A., 2010. Job mobility restriction mechanisms and appropriability in organizations: The mediating role of secrecy and lead time. *Technovation*, pp. 359-366.
- Delerue, H. & Lejeune, A., 2011. Managerial secrecy and intellectual asset protection in SMEs: The role of institutional environment. *Journal of International Management*, Volume 17, pp. 130-142.
- Delmar, F. & Wennberg, K., 2010. *Knowledge Intensive Entrepreneurship*. Northampton: Edward Elgar.
- Dickson, P., Weaver, K. & Hoy, F., 2006. Opportunism in the R&D alliances of SMES: The roles of institutional environment and SME size. *Journal of Business Venturing*, Volume 21, pp. 487-513.
- Edwards, K. & Gordon, T., 1984. *Characterization of innovations introduced on the U.S. market in 1982*, Connecticut: The Futures Group.
- Eeckhout, J. & Jovanovic, B., 2002. Knowledge Spillovers and Inequality. *American Economic Review*, pp. 1290-1307.
- Encaoua, D., Guellec, D. & Martínez, C., 2006. Patents systems for encouraging innovation: Lessons from economic analysis. *Research Policy*, 35(9), pp. 1423-1440.
- Espacenet, 2012. *Espacenet*. [Online]
Available at: <http://nl.espacenet.com/>
[Accessed 15 May 2012].
- EUROSTAT, 2008. *Patent applications to the EPO and patents granted by the USPTO, 2000-2008*. [Online]
Available at: epp.eurostat.ec.europa.eu
[Geopend 6 February 2012].
- Fallick, B., Fleischman, C. & Rebitzer, J., 2006. Job-Hopping in Silicon Valley: Some evidence concerning the microfoundations of high-technology cluster. *The Review of Economics and Statistics*, 88(3), pp. 472-481.
- Fritsch, M. & Franke, G., 2004. Innovation, regional knowledge spillovers and R&D cooperation. *Research Policy*, pp. 245-255.
- Gallié, E. & Legros, D., 2012. French firms' strategies for protecting their intellectual property. *Research Policy*, pp. 780-794.
- Gans, J., Hsu, D. & Stern, S., 2002. When does start-up innovation spur the gale of creative destruction?. *Rand Journal of Economics*, 33(2), pp. 571-586.
- Grant, R., 1996. Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Strategic Management Journal*, pp. 375-387.
- Guellec, D. & van Pottelsberghe de la Potterie, B., 2001. *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*, Brussels: OECD.
- Haahti, A., Madupu, V., Yavas, U. & Babakus, E., 2005. Cooperative strategy, knowledge intensity and export performance of small and medium sized enterprises. *Journal of World Business*, pp. 124-138.

- Hall, B., Helmers, C., Rogers, M. & Sena, V., 2012. *The choice between formal and informal intellectual property: a literature review*, Cambridge (MA): NBER Working Paper Series.
- Hallin, C. & Holmström Lind, C., 2012. Revisiting the external impact of MNCs: An empirical study of the mechanisms behind knowledge spillovers from MNC subsidiaries. *International Business Review*, pp. 167-179.
- Hall, J. & Scobie, G. M., 2006. *The Role of R&D in Productivity Growth: The Case of Agriculture in New Zealand: 1927 to 2001*, Wellington: New Zealand Treasury Working Paper.
- Hall, M., Oppenheim, C. & Sheen, M., 2006. Barriers to the use of patent information in UK small and medium-sized enterprises. *Journal of Information Science*, pp. 87-99.
- Hannah, D., 2005. Should I Keep a Secret? The Effects of Trade Secret Protection Procedures on Employees' Obligations to Protect Trade Secrets. *Organization Science*, 16(1), pp. 71-84.
- Harabi, N., 1995. Appropriability of Technical Innovations: An Empirical Analysis. *Research Policy*, pp. 981-992.
- Hertzfeld, H., Link, A. & Vonortas, N., 2006. Intellectual property protection mechanisms in research partnerships. *Research Policy*, pp. 825-938.
- Hurmelinna-Laukkanen, P., 2009. The availability, strength and efficiency of appropriability mechanisms - protecting investments in knowledge creation. *International Journal of Technology Management*, pp. 282-290.
- Jaffe, A., 1986. Technological Opportunity and Spillovers of R&D: Evidence from firms Patents, profits and Market Value. *The American Economic Review*, pp. 984-1001.
- Jaffe, A., 1989. Characterizing the "technological position" of firms with application to quantifying technological opportunity and research spillovers. *Research Policy*, pp. 87-97.
- Johnson, G., Scholes, K. & Whittington, R., 2009. *Fundamentals of strategy*. Madrid: Prentice Hall Financial Times.
- Kamer van Koophandel, 2010. *Ondernemersprofiel 2009 - Ondernemers in beeld*, sl: Kamer van Koophandel.
- Keizer, J., Dijkstra, L. & Halman, J., 2002. Explaining innovative efforts of SMEs: An exploratory survey among SMEs in the mechanical and electrical engineering sector in The Netherlands. *Technovation*, pp. 1-13.
- Lee, M. R. & Lan, Y.-C., 2011. Toward a unified knowledge management model for SMEs. *Expert Systems with Applications*, pp. 729-735.
- LEI, 2012. *Aantal bedrijven naar aantal melk- en kalfkoeien per bedrijf, naar provincie en hoofdbedrijfstype (NSO)*. [Online]
Available at: www3.lei.wur.nl
- Leiponen, A. & Byma, J., 2009. If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies. *Research Policy*, pp. 1478-1488.
- Levin, R. et al., 1987. Appropriating the returns from industrial research and development. *Brookings Papers on Economic Activity*, pp. 783-832.
- Lieberman, M. & Montgomery, D., 1998. First-Mover (Dis)Advantages: Retrospective and link with the Resource-Based View. *Strategic Management Journal*, Volume 19, pp. 1111-1125.
- Louwaars, N. et al., 2009. *Breeding Business (The future of plant breeding in the light of developments in patent rights and plant breeder's rights)*, Wageningen: Centre for Genetic Resources (CGN).
- Louwaars, N. et al., 2005. *Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries*, Wageningen: Wageningen University.
- Management Studies / Business Administration Group, 2011. *BSc Thesis, MSc thesis and Academic internship*, Wageningen: Management Studies Group.

- Mankiw, N. & Taylor, M., 2008. *Macroeconomics. European edition*. New York, Hampshire: Worth Publishers.
- Mansfield, E., 1986. Patents and innovation: an empirical study. *Management Science*, Volume 32, pp. 173-181.
- Maslow, A., 1953. The theory of human motivation. *Psychol Rev*, Volume 50, pp. 370-379.
- Ministerie van E, L & I, 2011. *Agrofood- en tuinbouwsector in innovatietop*. [Online] Available at: <http://www.rijksoverheid.nl/onderwerpen/ondernemersklimaat-en-innovatie/nieuws/2011/07/07/agrofood-en-tuinbouwsector-in-innovatietop.html> [Geopend 24 April 2012].
- MKB Nederland, 2012. *About us*. [Online] Available at: <http://www.mkb.nl/index.php?pageID=27> [Geopend 15 March 2012].
- Muller, E. & Zenker, A., 2001. Business services as actors of knowledge transformation: the role of KIBS in regional and national innovations systems. *Research Policy*, pp. 1501-1516.
- Olander, H., Hurmelinna-Laukkanen, P. & Heilmann, P., 2011. Do SMEs benefit from HRM-related knowledge protection in innovation management. *International Journal of Innovation Management*, 15(3), pp. 593-616.
- Olander, H., Hurmelinna-Laukkanen, P. & Mähönen, J., 2009. What's small size got to do with it? Protection of intellectual assets in SMEs. *International Journal of Innovation Management*, pp. 349-370.
- O'Leary, Z., 2004. *The Essential Guide to Doing Research*. London: Sage Publications: Thousand Oaks.
- Oxford University Press & Turnbull, J., 2010. *Oxford Advanced Learner's Dictionary*. Oxford: Oxford University Press.
- Romer, P., 1986. Increasing returns and long-run growth. *The Journal of Political Economy*, pp. 1002-1037.
- Scheppele, K., 1988. *Legal Secrets*, Chicago: University of Chicago Press.
- Simmonds, D. & Pedersen, C., 2006. HRD: the shapes and things to come. *Journal of Workplace Learning*, pp. 122-134.
- Slangen, L. H. G., Loucks, L. A. & Slagen, A. H. L., 2008. *Institutional economics and economic organisation theory: An integrated approach*. Wageningen: Wageningen Academic Publishers.
- Solow, R., 1957. Technical change and the aggregate production function. *Review of Economics and Statistics*, pp. 312-320.
- Symeonidis, G., 1996. *Innovation, Firm Size and Market Structure: Schumpeterian Hypotheses and some New Themes*, Paris: Organisation for Economic Co-operation and Development.
- Tappeiner, G., Hauser, C. & Walde, J., 2008. Regional knowledge spillovers: Fact or artifact. *Research Policy*, pp. 861-874.
- Teece, D., 2000. Strategies for Managing Knowledge Assets: the Role of Firm Structure and Industrial Context. *Long Range Planning*, pp. 35-54.
- Thornhill, S., 2006. Knowledge, innovation and ifrm performance in high- and low-technology regimes. *Journal of Business Venturing*, pp. 687-703.
- uit Beijerse, R. P., 2000. Knowledge management in small and medium-sized companies: knowledge management for entrepreneurs. *Journal of Knowledge Management*, p. 162.
- Vainman, V., 2008. Retention management as a means of protecting tacit knowledge in an organisation: a conceptual framework for professional services firms. *International Journal of Learning and Intellectual Capital*, pp. 172-185.
- van Calmhout, M., 2012. Nederland doet het als kenniseconomie iets beter. *Volkskrant*, 11 April.

- van Dijk, M., 2000. Technological regimes and industrial dynamics: the Evidence from Dutch Manufacturing. *Industrial and Corporate Change*, pp. 173-194.
- van Galen, M. & Verstegen, J., 2008. *Innovatie in de agrarische sector - We kunnen er niet genoeg van krijgen*, Den Haag: LEI Wageningen UR.
- van Leeuwen, M., de Kleijn, A., Pronk, A. & Verhoog, A., 2008. *Het Nederlandse agrocomplex 2007*, The Hague: LEI.
- van Leeuwen, M., de Kleijn, T. & Pronk, B., 2010. *Het Nederlandse agrocomplex 2010*, The Hague: LEI.
- Vernon Henderson, J., 2007. Understanding knowledge spillovers. *Regional Science and Urban Economics*, pp. 497-508.
- Verschuren, P. & Doorewaard, H., 2010. *Designing a Research Project*. The Hague: Eleven International Publishing.
- Vossen, R., 1998. Relative strengths and weaknesses of small firms in innovation. *International Small Business Journal*, 16(3), pp. 88-94.
- Wheeler, A., Halbesleben, J. & Harris, K., 2012. How job-level HRM effectiveness influences employee intent to turnover and workarounds in hospitals. *Journal of Business Research*, Volume 65, pp. 547-554.
- Wilcox King, A. & Zeithaml, C., 2003. Measuring Organizational Knowledge: a conceptual and methodological framework. *Strategic Management Journal*, pp. 763-772.
- Winnink, J., 2012. *Plantveredeling: De sector vanuit octrooiperspectief*, Rijswijk: NL Octrooicentrum.

Appendixes

Appendix I Questionnaire

Sector1. In welke sector is uw bedrijf actief? (Meerdere antwoorden zijn mogelijk)

- ☐ Veevoeding
- ☐ Gewas teelt
- ☐ Fokkerij
- ☐ Diergezondheid
- ☐ Stallenbouw/inrichting
- ☐ Melkstallen
- ☐ Mechanisatie
- ☐ Financiële service
- ☐ Anders:

Type bedrijf2. Wat voor type omschrijving past bij uw bedrijf

- ☐ Onafhankelijk bedrijf
- ☐ Familiebedrijf
- ☐ Dochteronderneming van ander bedrijf
- ☐ Joint Venture
- ☐ Beurs genoteerd bedrijf
- ☐ Anders:

Oprichting bedrijf3. In welk jaar is uw bedrijf opgericht (jaar)

Activiteiten4. Wat zijn uw bedrijf 's belangrijkste activiteiten? (b.v. verkoop, dienstverlening, advies, etc.)

Aantal medewerkers5. Hoeveel medewerkers heeft uw bedrijf? (antwoord in getal)

R&D6. Welk percentage van de omzet besteedde uw bedrijf gemiddeld de laatste 5 jaar gemiddeld aan Research en Development? (onderzoek en ontwikkeling van nieuwe producten en nieuwe processen, indien nodig maak een schatting)

R&D medewerkers7. Hoeveel medewerkers maken deel uit van de Research & Development activiteiten van uw bedrijf?

R&D samenwerking8. Welk percentage van uw bedrijf 's R&D activiteiten is in samenwerking met (maximaal 100% verdelen):

| | 0% | 25% | 50% | 75% | 100% |
|---------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Kleine bedrijven (<50 medewerkers) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | 0% | 25% | 50% | 75% | 100% |
|--------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Middelgrote bedrijven (50-250 medewerkers) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Grote bedrijven (>250 medewerkers) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Universiteiten | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Andere bedrijven | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Geen samenwerkingen | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Type bedrijven9. Met wat voor type bedrijven werkt u samen op R&D gebied

- ☐ Concurrenten
- ☐ Leveranciers
- ☐ Consumenten
- ☐ Geen samenwerkingen
- ☐ Anders:

R&D medewerkers10. Medewerkers die ingezet worden voor mijn bedrijf 's R&D activiteiten zijn cruciaal voor mijn bedrijf

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Innovaties11. Innovaties zijn voor uw bedrijf belangrijk om concurrerend te blijven

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Innovaties12. Hoeveel innovaties (nieuwe producten en/of nieuwe processen) heeft uw bedrijf de laatste 5 jaar ontwikkeld? (Maak indien nodig een schatting)

Concurrentie13. Ik heb het gevoel dat mijn concurrenten actie ondernemen om mijn producten/processen te imiteren

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Concurrentie14. Ik heb het gevoel dat mijn bedrijf lijdt doordat concurrenten mijn producten en processen proberen te imiteren

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Concurrentie15. Ik heb het gevoel dat mijn concurrenten nieuwe producten/processen ontwikkelen die nadelig voor mijn bedrijf kunnen zijn

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Concurrentie16. Ik heb het gevoel dat mijn bedrijf minder presteert doordat concurrenten nieuwe producten/processen ontwikkelen

1 2 3 4 5 6 7 8 9

Helemaal mee oneens ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Helemaal mee eens

Voormalig medewerkers17. Hoeveel voormalig medewerkers zijn een eigen bedrijf gestart in dezelfde sector de afgelopen 5 jaar? (Maak indien nodig een schatting)

Voormalig medewerkers18. Hoeveel voormalig R&D medewerkers zijn de afgelopen 5 jaar een eigen bedrijf gestart in dezelfde sector als uw bedrijf? (Maak indien nodig een schatting)

Voormalig medewerkers19. Hoeveel voormalig medewerkers zijn er bij een concurrent gaan werken de afgelopen 5 jaar? (Maak indien nodig een schatting)

Voormalig medewerkers20. Hoeveel voormalig R&D medewerkers zijn er in de afgelopen 5 jaar bij een concurrent gaan werken? (Maak indien nodig een schatting)


























Kennis21. Welk percentage van uw bedrijf 's specifieke kennis schat u dat er kan worden vastgelegd op papier?

Kennis *22. Probeert uw bedrijf haar kennis te beschermen voor uw concurrenten? (Zo nee, dan is dit het einde van de vragenlijst. Zo ja, beantwoord dan de volgende vraag)

- ☐ Ja
- ☐ Nee

Beschermingsmethoden23. Geef aan met percentages welke kennis uw bedrijf beschermt met:

| | 0% | 25% | 50% | 75% | 100% |
|------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Patenten | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Copyrights | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Merkenamen | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | 0% | 25% | 50% | 75% | 100% |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Ontwerp registratie |  |  |  |  |  |
| Concurrentiebeding in contracten van medewerkers |  |  |  |  |  |
| Lead time (de tijd die concurrenten nodig hebben om mijn kennis/innovaties te imiteren) |  |  |  |  |  |
| Geheimhouding |  |  |  |  |  |
| Human Resource Management (initiatieven om personeel te behouden zoals giften, kado's etc..) |  |  |  |  |  |