An Explorative study on the Relation between Patents and Venture Capital in the Semiconductor Industry

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1. Introduction

In the mid-1980s there was a rise in the number of patent applications and patent grants in the United States. This rise was especially present in the semiconductor industry. Research on this surge showed that it was mostly due to the increase of patenting by large manufacturing firms. However it was also noted that more small firms started entering the market, and that these new entrants were patenting more aggressively.

This rise of small firms and their patenting behavior was researched, and it was found that these new entrants patented in order to acquire Venture Capital. And although it is generally assumed that Venture Capitalists would value patents, literature on Venture Capitalists' selection criteria seldom mentions patents, focusing mostly on the management team, and the differentiation of the product (Chao-wen Mu, 2007). In recent years some research has been conducted on the relation between Venture Capital and Patents, but most of this research is quantitative. The fact that small firms patented in order to receive Venture Capital, and yet the literature seldom mentions Patents as a Selection Criterion, is rather peculiar.

Another issue that emerges is, why do Venture Capitalists prefer Patents over other Selection Criteria? Research (Arundel, 2001) has shown that small firms prefer secrecy as an appropriation mechanisms over Patents. It would seem that Venture Capitalists would have the same goals as small firms, and thus would have the same preferences for appropriation mechanisms.

This research aims to explore the relationship between Venture Capital and Patents in the Semiconductor industry, by answering two research questions on these topics:

- ***What is the role of Patents as a Venture Capitalist's Selection Criterion for Small Firms in the Semiconductor industry?***
- ***Why do Venture Capitalists prefer that the Small Semiconductor firms they invest in protect their innovations with Patents instead of other Appropriation Mechanisms?***

These two questions are the main focus of the research, and the aim of this research is to explore the relation between Patents and Venture Capital in small firms in semiconductor industry through in-depth interviews

This thesis starts in Chapter 2, which discusses the research topic, followed by the research question and the research objective. In chapter 3 and 4, the theoretical background is given for the research topics, which serves as a reference for the empirical research. In Chapter 5 the methodology of the empirical research is discussed, which discusses which methodological research choices have been made, and why these research methods were used. Chapter 6 discusses the Data found in the empirical stage, which is presented in the form of quotes. Finally in chapter 7 the findings are discussed, which will answer the research questions, and will propose further topics of research, which have been inspired by the empirical findings.

2 Research

This research focuses on the relationship between Venture Capital Investments in small firms in the Semiconductor Industry, and the presence of Patents in these firms. Research on this topic is still limited, and mostly quantitative. This thesis aims to explore this relation more thoroughly to uncover this relationship.

In this chapter the introduction of the thesis is given. Paragraph 2.1 discusses the research topic, which includes a short overview of what the research that has been conducted, and where this thesis focuses on. In paragraph 2.2 the research question and sub questions are given. These are the questions that this research aims to answer. Finally Paragraph 2.3 discusses the research objective

2.1 Research Topic

In the mid-1980s there was a rise in the number of patent applications and patent grants which was particularly noticeable in the semiconductor industry (Hall & Ham, 1999). Research on this rise showed that large firms mostly use patent as 'bargaining chips' in cross-licensing agreements. This research also showed that Small (design) firms in the semiconductor industry in the US patent in order to receive Venture Capital (Hall & Ham Ziedonis, 2001).

It seems that if small firms are patenting in order to receive Venture Capital, then Patents would rank high in Venture Capitalists' list of Selection Criteria. However the literature on Venture Capitalists' Selection Criteria, hardly mentions Patents. In Chao-wen Mu's literature review on the selection criteria by Venture Capitalists, only one article that discusses Patents is used. In a recent survey conducted by the BVCA (British Venture Capital Association), *'Clarity over IPR ownership'* and *'Level of IP Protection for the technology'* ranked as 6th and 7th in *'Ingredients for success from the venture capital perspective'*.

This apparent paradox is what this thesis aims to clarify, by exploring the relationship between Venture Capital and Patents in the Semiconductor Industry. Some research on this topic has been conducted, but this is very limited, and is mostly quantitative (Haeussler, Harhoff, & Müller, 2009; Hsu & Ziedonis, 2007; Mann, 2005) and does not thoroughly explore the relation between Venture Capital and Patents. The Quantitative research shows interesting results, but the real nature of how Venture Capitalists view Patents is still not very clear.

Some questions that emerge from this apparent paradox, and could help clarify the relationship are:

- Do small firms indeed need patents in order to receive Venture capital?
- How important are patents in relation to other selection criteria?
- Can a firm receive Venture Capital without owning patents?
- Once a Venture Capitalist invests, what is the course of action considering patents?
- How well do VCs study patents when deciding to invest?
- What is of importance when analyzing patents?

These question help explore the role of Patents as a Venture Capitalists' Selection Criterion.

Another topic of interest is the Venture Capitalists' preference of Patents over other appropriation mechanisms. Literature has shown that in general, small firms prefer Secrecy over Patents as an appropriation mechanism (Arundel, 2001).
There are a number of strategic reasons to patent and not to patent (Bertin & Wyatt, 1988; Harabi, 1995; Kingston, 2001; R. C. Levin, 1982; Mulder, 2006; Tidd, Bessant, & Pavitt, 2005) and a number of alternative appropriation mechanisms, that have their own benefits and drawbacks (Arundel, 2001; Cohen, Nelson, & Walsh, 2000; T. C. Levin, Klevorick, Nelson, & Winter, 1987; Tidd, et al., 2005).

It seems that if small firms prefer certain appropriation mechanisms, they have weighed the benefits and drawbacks of their choice, and have considered alternatives before deciding on a particular appropriation mechanism, so why do Venture Capitalists want the small firms to have Patents? Do the Venture Capitalists, with their expertise in the industry, see benefits that the small firms don't see, or do they consider the drawbacks not as important? Or do they simply want more security, and they feel that patents allow this? A number of questions that emerge and will help clarify the relationship are:

- What Advantages of Patents are important to the Venture Capitalist?
- How do Venture Capitalists View the Cost of Patents?
- How do Venture Capitalists View the Information Disclosed in a Patent?
- How big is the Risk of possible Litigation?
- Why don't Venture Capitalists find Secrecy a better Alternative?

These topics have not yet been researched in-depth, and it is not clear what the precise relationship is between Patents and Venture Capital. This thesis explores this relationship. To do this, in-depth interviews will be held with Venture Capitalists on how they view Patents. More on the research choices made can be seen in Chapter 5: Methodology.

2.2 Research Questions

This thesis aims to answer two research questions:

Research Questions:

- ***What is the role of Patents as a Venture Capitalist's Selection Criterion for Small Firms in the Semiconductor industry?***

- ***Why do Venture Capitalists prefer that the Small Semiconductor firms they invest in protect their innovations with Patents instead of other Appropriation Mechanisms?***

2.3 Research Objective

The objective of this thesis is to explore the relation between Venture Capital and Patents. The two main issues of this relationship that are researched are: Patents as a Venture Capitalists' Selection Criterion in the Semiconductor industry, and Venture Capitalists' preference for Patents over other appropriation mechanisms. The relationship between Venture Capital and Patents has not been researched extensively (Haeussler, et al., 2009), and the research that has been conducted is mainly quantitative. This thesis aims to explore this area more thoroughly, by interviewing Venture Capitalists on this issue, which will hopefully lead to more insight into the relation, and the interviews will hopefully give information that can be used as a starting point for future research. Because of time constraints, only Venture Capitalists are interviewed, and consequently the aim of this research is only get the point of view of the Venture Capitalists. This thesis aims to clarify these topics from the Venture Capitalist's point of view, and give rise to new questions that can guide the next research to explore this topic further.

3 Theoretical Background: Patents as Selection Criteria for Venture Capitalists.

Research on the 1980s patent surge in the US revealed that new entrants in the semiconductor industry patented in order to secure financing. The research on this surge focused mostly on large firms, but revealed that small and new firms that entered the industry after 1982 patented more aggressively, and that their reason for patenting was to acquire Venture Capital.

This research suggests that Venture Capitalists highly value Patents; However literature on the selection criteria of Venture Capitalists seldom mentions patents (or even IP), and the relation between patents and Venture Capital has also not been researched thoroughly. In the past few years some research has been done on the relation between patents and VC, but this is mostly quantitative, and does not give us insight on how Venture Capitalists truly view Patents and how they are valued.
This chapter reviews the literature on the patent rise that started in the 1980s and on Venture Capital Selection Criteria. This literature review will serve as a theoretical background for this thesis, which researches to what extent VCs want small firms to own patents, and why patents are of importance to Venture Capitalists.

In paragraph 3.1 the patent rise the history of patenting in the semiconductor is discussed, including the rise in the mid 1980s and the different explanations for this rise. In paragraph 3.2 the use of patents by large firms is reviewed. This paragraph shows for what reasons large firms use patents, and this paragraph will show the difference between large and small firms in their patenting behavior. Paragraph 3.3 reviews the use of patents by small firms, starting with the rationale of why small firms would want to use patents, to how they actually perceive patents and why they patent. Paragraph 3.4 reviews the relation between Venture Capitalists and Patents. This starts with what Venture Capitalists consider important selection criteria to invest, and the literature on Venture Capital and Patents. This chapter concludes with paragraph 3.5, which summarizes the information from the paragraphs, and discusses what questions should be answered by the empirical research.

3.1 History of Semiconductor Industry and Patents

In the 1980s patenting in the US rose considerably. This was mainly due to large firms increasing their patenting, but small firms also played significant role. To research the role of the small firms, the history of patenting and the patent rise is discussed in this paragraph first. This chapter starts with an early history of the semiconductor industry and patents, followed by the rise of patenting in the 1980s in the semiconductor industry. This chapter concludes with a summary of the literature that aims to explain this surge, both across technologies, and the literature focusing on the patent surge in the semiconductor industry.

3.1.1 Early History of Semiconductor Industry and Patents

In 1947 the transistor was invented in Bell Laboratories. The transistor was the start of the semiconductor industry, and since the invention of the transistor, the semiconductor industry has taken of in high speed. This rise in Intellectual Property (IP) was accompanied by a rise of IP protection. At the start of the semiconductor industry, there were a few American firms that produced most of the innovations in the Semiconductor industry (Tilton, 1971) (Braun & MacDonald, 1982). In the 1950s the total number of patents granted in semiconductors in the United States was 1317, of which 597 were to a small group of large firms. In France the total number of patents granted to firms from France, Great Britain and Germany combined was 818 (Tilton, 1971). An overview of patents granted in the US can be seen in Table 1 *(See also Appendix C:* Table 5*,* Table 6*,* Table 7 and Table 8)

TABLE 1: PERCANTAGE OF US SEMICONDUCTOR PATENTS

	1952	1953	1954	1955	1956
Bell Laboratories	56	51	46	37	27
Established firms	37	40	38	42	53
New firms	7	9	16	21	20

In the early 1950's AT&T (of which Bell Laboratories was a part) had a patent-pooling agreement with General Electric, RCA and Westinghouse. This meant that these companies could use each others patents free of charge. According to the American Justice Department this meant that AT&T had a near monopoly over US telecom equipment and ordered the 1956 consent decree. This meant that the company had to license all existing patents royalty free to US firms and the license price on future patents had to be reasonable (Tilton, 1971) (Wilson, Ashton, & Egan, 1980) (Braun & MacDonald, 1982). This decree lead to other firms also adopting a liberal licensing policy, out of fear that the Justice Department might also sue them, which meant that the importance of patents was limited (Wilson, et al., 1980).

However in those days AT&T was already providing licenses at very reasonable rates and organized seminars on their new discoveries. In those days, they argued that sharing

information was beneficial to them as well, because of the innovations of other companies, that AT&T could benefit from (R. C. Levin, 1982).

In the years that followed patents were not an important part of companies' business strategy and the access to important patents lead to an increase in competition and entry of small and new firms (Wilson, et al., 1980). The innovation speed was so high that a lot of firms did not patent and firms that did rely on patents were left behind (Braun & MacDonald, 1982).

3.1.2 The Rise of Patenting in the Semiconductor Industry

As the previous subparagraph suggests, until the end of the 1970s and half-way into the 1980s, the rise of patents was limited. However the 1980s saw a rise in the number of patents, which was visible in a number of industries, but especially in the semiconductor industry, as can be seen in Figure 1. This figure shows that from a relative constant and small growth of patents, the number of patent grants per year increased. Figure 2 shows that relatively to the investment in R&D this rise was especially large in the semiconductor industry. In Figure 2, it can be seen that the semiconductor shows a clear rise when compared to other industries, even pharmaceuticals, which is generally considered an industry that relies heavily on patents.

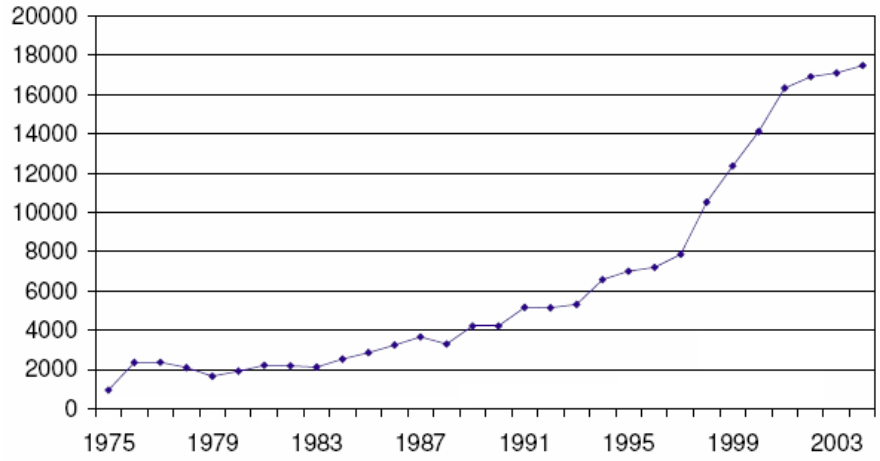

FIGURE 1: US PATENT GRANTS IN SEMICONDUCTOR TECHNOLOGIES (HALL & HAM ZIEDONIS, 2007)[1]

[1] The original figure included another graph that was deleted for a better overview.

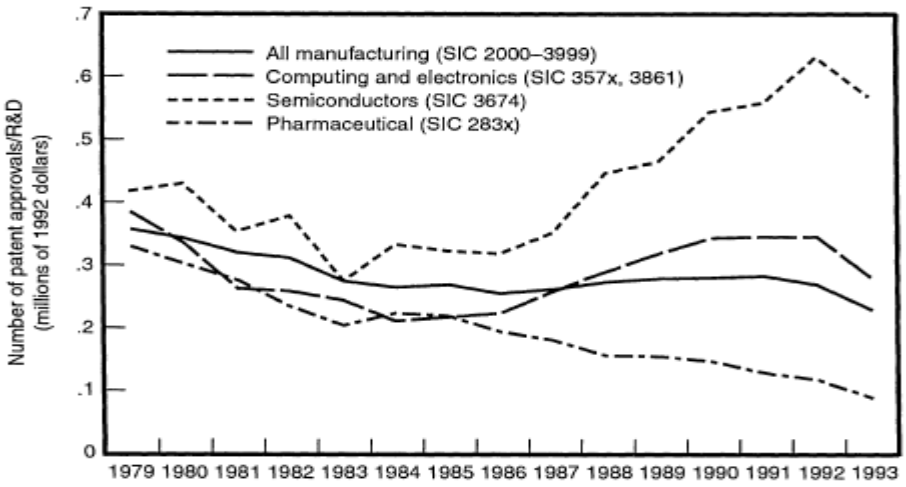

FIGURE 2: NUMBER OF PATENT APPROVALS / R&D EXPENDITURE IN THE US (HALL & HAM, 1999)

Although large firms were mostly responsible for the patent rise in the 1980s in the US, small firms also played a role. There was a rise of new entrants in the semiconductor industry, and these new entrants were patenting more aggressively (than firms entered before 1982) (Hall & Ham, 1999).

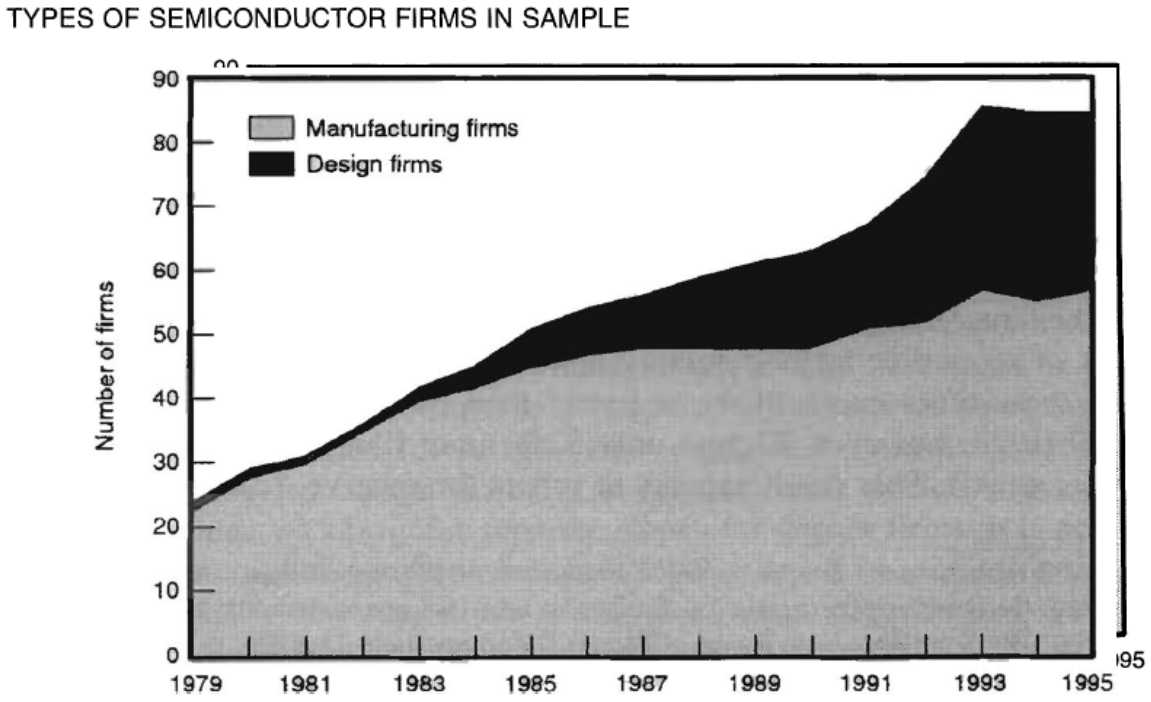

FIGURE 3: SMALL AND LARGE FIRMS IN THE SEMICONDUCTOR INDUSTRY (HALL & HAM ZIEDONIS, 2001)

3.1.3 Different Theories

The previous paragraph shows that patenting in the semiconductor industry went from a stable growth to a surge that started in the 1980s. This surge was not restricted to the Semiconductor industry, but compared to its investment in R&D did stick out. Research on this surge has been conducted, both of the entire patent surge, and the specifically the semiconductor industry.
Kortum & Lerner (1998) researched the entire patent rise, and tested some hypotheses. Hall and Ziedonis (1999, 2001) focused purely on the patent rise in the semiconductor industry in the United States.

Patent Surge

Kortum and Lerner (1998) tested four hypotheses for this surge:

- The "friendly court" hypothesis, which suggest that the surge was due to the establishment the Court of Appeals of the Federal Circuit in 1982, which is a specialized appellate court to hear patent cases. The decisions made by this new court were considered to be pro-patent (Merges, 1992).

- The "regulatory capture" hypothesis, which meant that large firms used lobbying in order to change the legal environment to their benefit.

- The "fertile technology" hypothesis, which meant that because technological opportunities were bigger, especially in certain industries such as biotechnology, information technology and software industries, there would be more innovation and thus more patenting.

They conclude by way of elimination, that the cause of the surge is a variant of the 'fertile technology' hypothesis. Namely that it was not that there were more innovations, but rather that companies changed their R&D management, and that firms moved from basic research to more applied research, which gives more possibilities for patents.
It must be noted that allowing patenting of software and business models also increased the number of patents. However Kortum & Lerner do not discuss this, and since this thesis is on the patent surge in the semiconductor industry, it is not taken into account.

Semiconductor Industry

Hall & Ziedonis (1999, 2001) use the research of Kortum & Lerner to research the patent surge in the semiconductor industry. However contrary to Kortum and Lerner's results, they found that in the semiconductor industry, rather than a change in R&D management, the cause of the surge was a variant of what Kortum and Lerner call the 'friendly court' hypothesis. They claim that the legal changes and precedence, which were considered 'pro-patent' because patent holders were better protected, were the result of the surge of patenting.

Their study reveals two main reasons for the rise of patents in the semiconductor industry:

- Use of patents as 'bargaining chips' in negotiations, to gain access to new sectors, or to avoid litigation risk. This is mostly by large, capital-intensive manufacturing firms.

- New entrants in the by design firms, which patent more aggressively. These firms attribute this change in patenting behavior to the fact that patent rights are needed in order to acquire Venture Capital.

This second finding is of great interest. Their research shows that new firms entering the market were patenting more aggressively (than firms entered before 1982. From interviews they found that small firms patented more in order to acquire Venture Capital, and quantitative research backed up these statement, and showed that indeed *'patent rights are required to secure venture capital and other financing for entry'.*

These finding are an important fact for this thesis. New firms in the Semiconductor industry started patenting more aggressively, because they wanted to acquire Venture Capital(Hall & Ham Ziedonis, 2001).

3.2 Large Firms

The previous paragraph showed that that large firms patent mostly for strategic reasons. This will be further reviewed in this paragraph.
This thesis is on the patenting of small firms and the role of VC in this process. However most of the patents filed are by large firms, who where also the main reason for the patent rise in the 1980s and discusses the patenting behavior of the large firms in the semiconductor industry. This paragraph serves as a reference to which the patenting behavior of small firms can be compared.

3.2.1 Appropriation

In the previous paragraph it was shown that in the semiconductor industry patenting is abundant. This seems to suggest that semiconductor firms consider patenting to be a useful appropriation mechanism. However this is not the case. When studies are compared, it seems that the value of patents as an appropriation mechanism have not changed (Cohen, et al., 2000; T. C. Levin, et al., 1987), and patents are not considered to be very important.

In 1987, Levin found that the use of patents as appropriation mechanism was not considered very important by semiconductor firms (T. C. Levin, et al., 1987). What is surprising is that the importance given to patents as appropriation mechanisms has not changed over time. In 2000, Cohen found that in only 26,67% of product innovations and 23.33% of process innovations, were patents considered an effective appropriation mechanism in the semiconductor industry (Cohen, et al., 2000).

It seems that there are two other appropriation mechanisms that are considered superior by semiconductor firms, namely Secrecy and Lead time or First Mover Advantage.

Secrecy

It seems that in the semiconductor industry, the appropriation mechanism that is rated most useful is secrecy. For product innovations, for 60% of the innovations secrecy was an effective appropriation mechanism, and for process innovations this was 57.50% (Cohen, et al., 2000). Hall and Ziedonis also found that secrecy was the most important appropriation mechanism (Hall & Ham, 1999; Hall & Ham Ziedonis, 2001).

Lead time/First Mover Advantage

Another appropriation mechanism that is valued better than patents is lead time, also known as First Mover advantage. This means staying ahead of competitors and having the newest innovation, with which a significant market share can be acquired before the competition can commercialize a similar product.

It must be noted that First Mover Advantage can not be created on its own, and is usually related to other issues, such as manufacturing know-how, and tacit knowledge. More on the alternatives to patents can be found in Paragraph 4.4.
Because of the speed of development in semiconductors, First Mover Advantage is an important aspect of appropriation of innovations. This appropriation mechanism is used in combination with secrecy, because when the innovation is kept secret until launch, this is also translated into a longer lead time. For product innovations lead time is important for 53.33% of innovations and for process innovations for 47.78% (Cohen, et al., 2000).

This paragraph showed that although the number of patent grants increased greatly in the semiconductor industry, the use of patents as appropriation mechanisms has remained low and other forms of appropriation mechanisms are still favored by large firms.

3.2.2 Use of Patents

In Paragraph 3.1.2, we saw that there was an enormous surge of the number of patents in the semiconductor industry, and that this was mainly due to large firms. However in Paragraph 3.2.1, it was shown that large firms prefer other forms of appropriation. These results are rather confusing, and question emerges: If large firms don't use patents as appropriation mechanisms, what do they use patents for?

Research shows that there are a number of reasons why large companies in the semiconductor industry patent, and that these reasons are mostly strategic.

Prevent Copying

In the 2000 survey by Cohen, 91.67% of semiconductor companies indicated that prevention of copying was one of the reasons they patented product innovations. This was the same percentage for process innovations (Cohen, et al., 2000). Hall and Ham also found that when semiconductor firms patent, one of the reasons is to safeguard against theft (Hall & Ham, 1999). However Cohen found that other reasons were also important (although not as important as prevention of copying) and Hall and Ham found that the role of patents seems to be dominated by a broader use of patents, and that prevention of copying is of limited importance.

Blocking

Another important reason to patent is to block innovative endeavors of competitors. By patenting crucial innovations, competitors might not be able to circumvent these patents, and their innovation in this area is blocked. Cohen (2000) showed that in 75% of product innovations and 58.33% of process innovations patent are used to block competition in the semiconductor industry (Cohen, et al., 2000). Hall and Ham found that blocking and preventing being blocked are even more important than prevention of copying (Hall & Ham Ziedonis, 2001).

Licensing and Bargaining Chips

A reason that is said to be the most important one is the use of patents as bargaining chips (Hall & Ham Ziedonis, 2001). This means the negotiation power associated with patents. These bargaining chips deals usually result in licensing and cross-licensing, which is an important aspect of the knowledge flow in the semiconductor industry (Grindley & Teece, 1997). Acquiring patents to use as 'bargaining chips' has a number of reasons:

- Royalties
- To Avoid being held up in innovation
- To mitigate litigation risk (Kodak)

The most straightforward use of patents as bargaining chips is to receive royalties. By licensing the patents to other firms, a fee can be charged for the use of the patent. Licensing revenues can be an important source of income. In 1998 IBM had licensing revenues of $1 billion dollars (Tidd, et al., 2005). And Texas Instruments, a semiconductor firm, had a licensing revenue of $500 million in 1993 (Grindley & Teece, 1997).

Perhaps the most important reason companies in the semiconductor industry patent, is to avoid being held up in their innovation. Cross-licensing is a practice that occurs often in the semiconductor industry. This means that companies agree to license their patents to each other, so neither is blocked by patents of the other. If the patent stock is not equal, then additional payment is made (Grindley & Teece, 1997). This practice of cross-licensing leads to a knowledge flow in the industry, and avoids companies being held up in innovation. To assure that companies can make these cross-licensing transactions, patenting is essential.

Mitigating the risk of litigation is another important reason to patent. Two events led to fear the which resulted in a drastic changing in patent strategy in semiconductor firms (Hall & Ham Ziedonis, 2001). The first event was the Kodak-Polaroid case that was settled in 1990. It was ruled that Kodak had infringed on Polaroid's patents and had to pay Polaroid $US 925 million, to its lawyers $US100 million and to its customers $US500 million. It closed a manufacturing plant at the cost of $1.5 billion and had to fire 700 employees (Rivette & Klein, 2000). The other case was Texas Instruments' successful reinforcement of its patents. This made companies realize that the big firms were asserting their patents and that they could be at risk if they did not change their patent strategy themselves (Hall & Ham Ziedonis, 2001).
Patents mitigate litigation risk by showing that a firm is active in a certain innovative area and has protected its innovations, which deters litigation. Furthermore a large patent portfolio allows for countersue if the company is being sued.

3.3 Small Firms

In the previous paragraph we have seen why large firms in the semiconductor industry patent: as bargaining chips in licensing and cross-licensing agreements. Hall & Ziedonis showed that small firms in the semiconductor industry patent in order to receive Venture Capital (paragraph 3.1.3).

Small firms however do not have the resources or patent portfolio to enter these cross-licensing agreements. The rise of patenting showed that small firms do patent, but they do not have the same objectives as large firms, but that they patent in order to receive Venture Capital.

This paragraph reviews the literature on patenting by small firms in general. Although this is not research does not focus specifically on the semiconductor industry, this does show how small firms (including those in the semiconductor industry) feel about patents. Paragraph 4.3.1 starts with the rationale of why small firms should want to patent (which is often used as a legitimization of the patent system: because it protects small firms). This is followed by a review of how small firms really feel about the patent system. This paragraph concludes with a review of the use of the patent database by small firms.

3.3.1 Rationale of Small Firms and Patents

The literature has traditionally argued that the patent system especially benefits small and new companies (Mazzoleni & Nelson, 1998); this traditional view has dominated thinking for a long time. The reasoning used is as follows: if there is no legal protection of the innovation of a small firm, a large firm can use its relatively large resources to copy and market the product, without having to have invested money in R&D. This would mean small firms would not be able to reap the benefits of their innovation, and would mean small firms would stop innovating. Because large firms are much more efficient in the execution of commercialization, large firms can copy the innovation of small firms, and the small firms are left with nothing.

3.3.2 How small firms value the patent system

The above described rationale of why patents benefit small and new companies seems very reasonable. However empirical research has shown that small and new companies don't value patents more than large firms. In fact, they find them less important. Arundel shows that there is a relation between the importance placed on product patents and the size of the company. The larger the company, the more they prefer patents over secrecy (Arundel, 2001). For process patents there is no clear relation, but again small firms prefer secrecy. The results of his research can be seen in Table 2.

TABLE 2: RELATIVE IMPORTANCE OF PATENTS AND SECRECY FOR ALL R&D-PERFORMING FIRMS (ARUNDEL, 2001)

Relative importance of patents and secrecy for all R&D-performing firms (standard errors in parentheses)

Employees	*N*	Product innovations			Process innovations		
		Patents more important	Equal importance	Secrecy more important	Patents more important	Equal importance	Secrecy more important
< 19	183	17.5 (2.8)	38.3 (3.6)	44.3 (3.7)	10.4 (2.3)	40.4 (3.6)	49.2 (3.7)
20–49	386	17.6 (1.9)	23.6 (2.2)	58.8 (2.5)	12.4 (1.7)	27.5 (2.3)	60.1 (2.5)
50–99	452	23.0 (2.0)	28.5 (2.1)	48.5 (2.4)	11.1 (1.5)	37.4 (2.3)	51.5 (2.4)
100–249	668	20.7 (1.6)	28.0 (1.7)	51.3 (1.9)	11.8 (1.3)	35.9 (1.9)	52.2 (1.9)
250–499	479	20.5 (1.8)	30.1 (2.1)	49.5 (2.3)	12.3 (1.5)	29.6 (2.1)	58.0 (2.3)
500–999	319	24.5 (2.4)	24.8 (2.4)	50.8 (2.8)	9.7 (1.7)	23.2 (2.4)	67.1 (2.6)
1000–1999	186	23.7 (3.1)	33.9 (3.5)	42.5 (3.6)	10.8 (2.3)	30.6 (3.4)	58.6 (3.6)
> 2000	176	30.7 (3.5)	26.1 (3.3)	43.2 (3.7)	19.9 (3.0)	23.3 (3.2)	56.8 (3.7)
Significance of the trend by size				$p < 0.0001$			ns

Furthermore, 'Lerner (1994) shows that small firms are far more likely to "opt out" of the patent system entirely and rely more heavily on formal trade secret mechanisms to protect their inventions' (Hall & Ham Ziedonis, 2001)

However research conducted in 2001, which asked small firms 'why' they patented, showed that besides patenting in order to receive Venture Capital, most small firms in the semiconductor industry did patent in order to improve market position (Hall & Ham Ziedonis, 2001).

This shows that although the empirical research does not provide definitive results on how small firms feel about patents (especially those in the semiconductor industry), it does seem that small firms do not rely on patents more heavily than large firms, and in fact may prefer other appropriation mechanisms.

3.3.3 Patent Database

A second reason traditionally given that especially small and new companies benefit from a patent system is the information small companies can get from the patent databases. It is argued that large companies have a large research and marketing department and can get information for new innovations from inside the company. Small companies on the other hand do not have a large access to information and therefore the patent databases are a perfect place to get ideas for new products.

However research conducted by Arundel and Steinmueller, and MacDonald show that small companies rate the patent database as an unimportant source of technical information. Furthermore the main sources of technical information for SMEs are customers and suppliers and the patent database does not play an important part at all (Arundel & Steinmueller, 1998; MacDonald & Lefang, 1997).

3.4 Venture Capitalists' Selection Criteria

The previous paragraphs have shown the rise of patenting in the semiconductor industry, and the reasons large and small firms apply for patents. This paragraph reviews the selection criteria Venture capitalists use when deciding to invest in a start-up.

3.4.1 Selection Criteria

Literature on the selection criteria of venture capitalists is abundant and focuses on many different aspects. The focus of most research has been the entrepreneur or management team. However, over the years other aspects have been analyzed. This paragraph reviews the literature and categorizes the selection criteria into four categories, as seen in (Chao-wen Mu, 2007).

A thorough analysis of the selection criteria literature has been made by Chao-wen Mu (2007). In this analysis, the decision criteria have been categorized into four areas (Chao-wen Mu, 2007):

- Management Team
- Features of products or services
- Attractiveness of the market
- Financial Considerations

These topics are again made up of other parts, as can be seen in Figure 4.

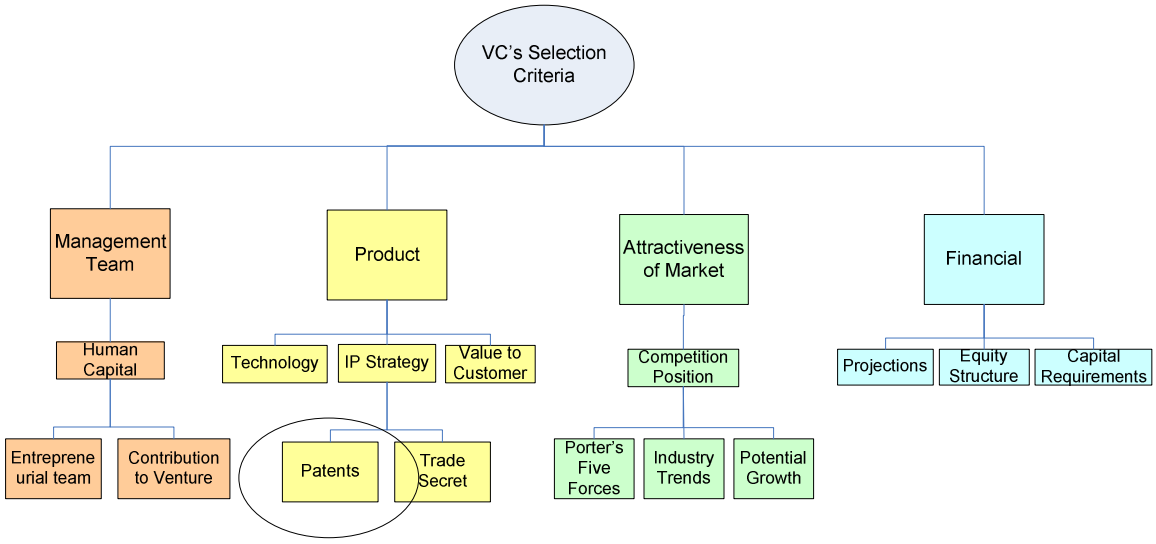

FIGURE 4: OVERVIEW OF VC SELECTION CRITERIA (VISUAL REPRESENTATION BASED PARTLY ON)(CHAO-WEN MU, 2007)

Note that this is no definitive list of Venture Capitalists' Selection Criteria, and that no definitive list exists

Management

Although there is no definite list of criteria or ranking, a very important aspect is the entrepreneurial team (Chao-wen Mu, 2007; Mann, 2005; Rourke & Keeley, 1990; Tyebjee & Bruno, 1984). An important aspect of the entrepreneurial team is the experience in the field they are entering. Other aspects of the entrepreneurial team include the marketing and R&D skills of the entrepreneurial team (Tyebjee & Bruno, 1984). According to Rourke & Keeley (1990), the personal characteristics of the entrepreneurial team are the least important factor.

Attractiveness of the Market

Venture Capitalists find the attractiveness of the market an important aspect in deciding to invest. This category has a number of aspects, namely: Market size, Market growth, Competitive threat, Barriers to entry (MacMillan, Siegel, & Narasimha, 1985; Ruby, 1984; Tyebjee & Bruno, 1984). A tool that is often used in analyzing the market is Porter's Five Forces.

Financial Considerations

Because the essence of Venture Capital is high risk financing, it is hard to predict the financial returns on the investments. However because of experience, an expected overview of finances can be constructed, and the financial aspects are evaluated. Important issues are the size of the investment the Venture Capitalist has to make, the expected Rate of Return ((Poindexter, 1976; Tyebjee & Bruno, 1984), the percentage of Equity the Venture Capitalist will receive and the expected risk (Poindexter, 1976), to name a few.

Features of products or services

Features of the products and/or services focuses on everything to do with the product or service itself. This includes (amongst others) the technology, the novelty and intellectual property of the product/service and value to the customer. Patents are a part of this category, as can be seen in Figure 4. It can be argued that the most important aspect is the differentiation of the product (Tyebjee & Bruno, 1984).

A part of the features of the products/services is the protection of the product or service by patents. In Biotechnology there is evidence of patents playing a role in obtaining venture capital, with companies with a patent in a more favorable position to obtain VC financing and partners to commercialize activities (Haeussler, et al., 2009; Kenney, 1986; Lerner, 1994). In the semiconductor industry, Hsu & Ziedonis (2007) have discovered that 'a doubling application stock was associated with a 24% boost in funding-round firm value' (Hsu & Ziedonis, 2007). This research was quantitative in nature. Furthermore a survey done by the BVCA (British Venture Capital Association) showed that in case of University Spin-Outs, the 'Clarity of IPR ownership' and 'Level of IP Protection for the technology' ranked 6th and 7th on the list of most important factors for success (BVCA, 2005).

3.5 Summary and Raised Questions

This chapter reviewed the literature on the patent rise in the 1980s in the US, the patenting behavior of large firms and of small firms, followed by the selection criteria of Venture Capitalists when deciding to invest in a firm.

Research by Hall & Ziedonis (1999, 2001) has shown that small semiconductor firms in the US that entered the market post-1982, patented more aggressively, and the reason stated for this was to acquire Venture Capital.

Arundel (2001) showed that small firms in general actually prefer secrecy over patents as Appropriation Mechanisms, which suggests that small firms would not patent if it was not for the patent's ability to attract Venture Capital.

However the research on what Venture Capitalists consider important criteria, rarely mention patents. Some specific research does discuss this relation (Haeussler, et al., 2009; Hsu & Ziedonis, 2007), but is mainly quantitative, and does not explore the role of patents as selection criteria in-depth.

What this literature review shows is that the relation between Patents and Venture Capital Investments in Small Firms in the Semiconductor industry is not clear. A number of questions arise from this literature review:

- Do small firms indeed need patents in order to receive Venture capital?
- How important are patents in relation to other selection criteria?
- Can a firm receive Venture Capital without owning patents?
- Once a Venture Capitalist invests, what is the course of action considering patents?
- How well do VCs study patents when deciding to invest?
- What is of importance when analyzing patents?

The main question that arises from this literature review is:

What is the role of Patents as a Venture Capitalist's Selection Criterion for Small Firms in the Semiconductor industry?

4 Literature Review: Why Do VCs want Patents?

In the previous chapter the literature on relation between Venture Capitalists and Patents is reviewed, focusing on the rise of patents and the fact that Small Firms patent in order to receive Venture Capital.

Research by Hall & Ziedonis (1999, 2001) showed that small firms in the semiconductor industry use patents in order to acquire Venture Capital. However Arundel (2001) showed that small firms prefer secrecy as an appropriation mechanism over patents.

So if small firms prefer other appropriation mechanisms, and patent mainly to acquire Venture Capital, the question that emerges is:

Why do Venture Capitalists prefer that the Small Semiconductor firms they invest in protect their innovations with Patents instead of other Appropriation Mechanisms?

This chapter reviews the relevant literature related to this question, and reviews the benefits, drawbacks and alternatives to patents observed in the literature, and again discusses shortly how small firms view patents. This will give a theoretical background on the topic, which will serve as a reference for the empirical research and findings.

In Paragraph 4.1 the rationale of why patents were introduced and their original intent are described. This is followed in Paragraph 4.2 with a review of the Advantages of Patents, which deals with the benefits of Patents. In Paragraph 4.3 Disadvantages of Patents are reviewed, which deals with the drawbacks of Patents. In Paragraph 4.4 Alternative to Patents are reviewed, which discusses other ways to protect an innovation or to appropriate returns. Then in Paragraph 4.5 the trade-off between Secrecy and Patents is reviewed, in reference to how small firms view them. This chapter concludes with paragraph 4.6, which summarizes the information from the paragraphs, and discusses what questions should be answered by the empirical research. This information is a theoretical background for the empirical research.

NB. In this research only Venture Capitalists have been interviewed, which means that a possible difference in interest between Venture Capitalist and Small firm, when it comes to acquiring patents is not researched. Results from this research can be used in future research on this topic, but in this research this is not covered. Therefore literature on the different interests between investor and investee (VC and small firm) is not reviewed.

4.1 Rationale of Patents

Currently Patents are used for an number of strategic reasons, such as blocking competitors, or to acquire Venture Capital; however originally patents had a very specific goal and purpose. In fact, a patent was (and still is) seen as a contract between the inventor and society.

Patents were introduced as a win-win situation, in which both society and the inventor would benefit. When an invention is developed, the inventor would give the precise specifics of the innovation to society. In practice this means, the details of the innovation are given to the Patent Office, which makes it public. However if the information is public, this would mean anyone can copy it. This is why the inventor is given a monopoly on his invention for a certain period of time.

This system had the benefit for the inventor that he would have a legal protection of his invention, and that nobody could simply copy it. For Society this also had a number of benefits (Mazzoleni & Nelson, 1998). The main benefit was that there would be innovation. The monopoly given to the inventor is seen as an incentive for him to innovate. If there would be no legal protection, then competitors can simply reverse-engineer the innovation, copy it, and sell without having made the costs of research and development, and if there was no reward for innovation, people would stop innovating. This is why patents are beneficial for society, because they encourage innovation.

4.2 Advantages of Patents

As discussed in chapter opening, the benefits of patent have changed from protection of innovation to a number of strategic uses. Patents can be used for a number of other purposes, besides protecting an invention. And although patents were initially introduced in order to spur on innovation, their use has been can be used to actually deter innovation. This paragraph reviews the literature on the benefits of owning patents.

4.2.1 Protection

Prevention of Imitation

The first benefit that is usually associated with patents is the fact that competitors are not allowed to copy the innovation (Cohen, et al., 2000). This monopoly is of great value to a company, because there is no more direct competition for this particular product and the company can ask a premium price on the product or service. In this situation of a monopoly, economic theory predicts that a firm can make excessive profits (excessive meaning more than in competition) from the product or service (Harberger, 1954). However it should be noted that although the innovation and product or service can be unique, it is possible to have competition from a product that is based on another technology. *(Example: If there was a patent on shoes with laces, no-one else can sell this, and this company would have a monopoly. However the competition would be shoes with Velcro).*

Freedom-to-Operate

Another important benefit of Patents is the Freedom-to-Operate it allows; Freedom-to-Operate means not being blocked in innovation and commercialization by competitors.

Example: Two companies, Company A and Company B, are competitors that develop similar products, and the innovations are cumulative. If Company A patents its innovations, it will know that it commercialize its innovations, because it owns the patents. If it does not patent its innovations, Company B could patent some innovations that have also been developed by company A, but because Company B holds the patents, Company A is not allowed to commercialize the innovations. So Company A could patent, simply so it knows it is allowed to commercialize its innovations. This is called Freedom-to-Operate.

In the Semiconductor industry Freedom-to-Operate is an important issue, because a lot of the innovations overlap. This is why the large semiconductor firms cross-license patents, and allow competition to use each others patents. This is done purely so they all have a Freedom-to-Operate (Grindley & Teece, 1997)

Blocking

Another reason to patent is to block a competitor in his innovation. This is blocking the Freedom-to-Operate. By patenting innovations that competitors need, the competition can't commercialize its innovations, which gives a competitive edge (Bertin & Wyatt, 1988). Patenting with the intention to block competition is quite common, and in the semiconductor industry 75% of the participants declared blocking a reason to patent (Cohen, et al., 2000).

4.2.2 Licenses and Sale

Income from Licenses (or sale)

A common business-model is to license-out or sell patents. Especially smaller firms that do not have the resources to commercialize their own products prefer to license-out their patents. Although it is popular with small firms, large firms also license-out their patents. In 1998 IBM earned US $1 billion from licensing-out patents (Tidd, et al., 2005).

There are a number of strategies when licensing-out patents. There is the option between exclusive and non-exclusive license. An exclusive license means the patent is only licensed to one party, and for this exclusivity a premium can be asked. Furthermore there can be a fixed or variable (or combination of the two) type of remuneration. In a fixed remuneration, a price is asked for a certain period of time, regardless of the sales of the party that licenses-in the patent. In a variable remuneration, the compensation is dependant on the sales.

Another business-model option is to sell the patent. This means that all the rights of the patent are transferred to a third party. This is popular with innovative small firms that do mostly basic research and are not interested in the commercialization of an innovation.

Strong Position in License Negotiations

A strong patent portfolio can be very important in license negotiations (Kingston, 2001). Cross-licensing is a common practice in the semiconductor industry (Grindley & Teece, 1997), and to have a strong negotiation position, having a strong patent portfolio is beneficial. A high number of quality patents that are in demand with other firms gives a better negotiation position.

4.2.3 As a Strategic Signal

Prevent Firms from innovating in the same area

A Patent can send a strategic signal to competitors that a certain innovation has already been invented and protected, in order to scare them away from the area (Davis & Kjaer, 2003). When a patent is applied, it is listed and published. This publishing could deter competitors from innovating in this area, even if the patent changes in the process or isn't granted in the end.

Prevent Law Suits by showing the innovation is protected

A granted patent signals that a company owns this innovation. This a sign towards competitors, which could prevent law suit, because it shows competitors that the innovation is protected (Cohen, et al., 2000).

4.2.4 As indicators of value

To attract attention from external investors

Patents are sometimes used as an indicator of value. For an external party, a patent can signal value, through the promise of income, or as a signal of innovative and protected capability. Therefore an important advantage associated with the owning of patents is the attraction of investment (Grandstrand, 1999). In the semiconductor industry small firms have indicated that a reason to patent was to attract Venture Capital (Hall, 2005; Hall & Ham Ziedonis, 2001).

To measure results of their R&D investment

Another way patents can be seen as an indicator of value is not to the outside world, but rather to the firm itself. Usually patents (and patent citations) are used to track knowledge flows (Jaffe & Trajtenberg, 1996). However patents can also be used by a company to indicate the return on R&D investment (Bertin & Wyatt, 1988). However when using patents as an indicator, there is always the danger that only the indicator is changed, rather than the underlying process (i.e. the R&D department could start applying for more trivial patents than before, simply to boost the appearance of R&D output).

4.3 Disadvantages of Patents

With the strategic use of patents, as we have seen in the previous paragraph, a number of drawbacks have been associated with patents. With the invention of patents, the drawback that was observed was the information disclosed in the application, which was not a problem because a monopoly was granted. However in the current business-world, and with the strategic use of IP protection, patents also have a number of drawbacks. If for a particular innovation the drawbacks outweigh the benefits, it is advisable not to file for a patent. In this paragraph the literature on the drawbacks associated with owning patents is reviewed.

4.3.1 Cost

Currently one of the first drawbacks associated with patents is the cost of applying and maintaining patents (Mulder, 2006). Especially for small firms these costs can be very high. A study commissioned by the European Patent Office (EPO) found that 'the cost of obtaining a typical Euro-direct patent (validated in 6 countries, with 10 claims on 3 pages, 11 pages of description) was about €30,000 in 2003'[2]. Since one patent is usually not enough, but a portfolio has to be built around a product, this can be a very costly.

4.3.2 Disclosure of Information

Direction of Innovation

Another important drawback of patents is the disclosure of information. When applying for a patent, the precise invention has to be explained, and this information is then made public, where the competition can analyze it (Harabi, 1995). This information can have crucial implications. First of all, competitors will know exactly what your latest innovation is and how it works. The competition will know in which direction your innovation is going, and adjust their own paths.

Inventing around

Related to the disclosure of information is the risk of being invented around (Cohen, et al., 2000). When applying for a patent the information is made public, and competitors can see what was innovated, and how certain problems were solved. They can then use this information to invent a product that can essentially do the same, but by-pass the patent protection by inventing around certain key innovations.

[2] http://www.ipr-helpdesk.org/documents/HowMuchPatent_0000003793_00.xml.html

4.3.3 Infringement

Although technically a patent should protect against lawsuits, patents in fact are the cause of a lot of lawsuits. The European Patent Office (EPO) does check patents that may be related to a new patent application, this is never one hundred percent. And it is possible that the EPO did not feel the new Patent to be infringing on an existing one, while the firm that holds the existing patent does feel it is infringing, and will start a lawsuit. There are a number of costs involved with infringement, both when a patent is being infringed, and when the patent is infringing someone else's.

Being Infringed

A drawback that is becoming increasingly more important is the risk of infringement and litigation. There are two key issues involved with infringement (Kingston, 2001):

- Finding Infringement
- Suing Infringers

Finding infringers has varying difficulty, depending on the industry, but in the semiconductor industry this is particularly difficult. When it comes to the design of a microchip, the complexity and difficulty of reverse engineering make it very difficult to detect infringement. For the production of semiconductor products, finding infringement is even more difficult. These are often process patents, and to find the infringement it is usually necessary to go into the production plant, which is not possible. The way infringement is usually detected is when two parties have applied for separate patents, and one is suing the other for infringement. In this case detecting infringement is somewhat simpler, but still demands large commitment of resources to check patents.

Once infringement is detected, the course of action is also difficult. Whether the result of the lawsuit is positive or not, the legal fees are very high. So the costs associated with finding and suing infringers is high, which is considered a drawback for owning a patent.

Infringing

In the previous scenario, the patent of a company was being infringed. However a patent can also infringe someone else's patent. When applying for a patent, a search is done on related patents, but this is never 100% and sometimes the infringement is not clear. This will bring legal costs if the other party sues, and could even result in the company needing to discontinue the commercialization of the innovation.

Because semiconductor products are complex and difficult to reverse engineer, infringement is usually only noticed if a patent is filed on this innovation. Therefore not applying for a patent will also strongly decrease the likelihood of being sued for infringement.

4.4 Alternatives to Patents

Protection of Intellectual Property is an important issue for high-tech companies, because their main capability is usually their innovativeness. The legal protection that has been introduced in most countries is patents. However a number of alternatives to patents have been developed by companies, because they felt the advantages of patents did not weigh up against the disadvantages, and they felt other forms of IP protection were better suited to their needs.

This paragraph reviews the literature on the alternatives to patents, and shortly describes their way of protection and their advantages and disadvantages.

4.4.1 Different options[3]

Besides Patents, there are a number of alternatives in order to protect intellectual property, or to stay ahead of competition. This subparagraph reviews the different alternatives. It is important to note that most of these alternatives work in combination with each other, and that most would not work separately. In this paragraph the separate advantages and disadvantages are reviewed. If one of the mechanisms simply cannot exist without others, this is mentioned.

Secrecy

Keeping a new innovation secret is thought to be an effective way to protect innovation, especially process innovations. Since the process is done behind closed doors, keeping it secret is relatively easy, whereas tracking down infringement (if it were patented) is difficult. It was shown that (for all company sizes), companies prefer secrecy to patents, for product innovations and especially for process innovations (Arundel, 2001). Secrecy has the benefit of nobody knowing the inner workings of the innovation, which also prevents competitors to know the innovative direction or to invent around. However if the information is made public, there is no legal protection. Another disadvantage is, that if another company develops the same innovation and does patent it, you can no longer commercialize your innovation.

Accumulated Tacit Knowledge

Accumulating tacit knowledge means having the key-people that have tacit knowledge (which is usually the result of experience) on innovation and processes and with this knowledge create competitive advantage in a multitude of ways. Accumulating tacit knowledge is a difficult process that takes time, money and a good HR management to retain valuable personnel. The advantage is that once tacit knowledge is acquired through experience, it is an asset to the company that is very difficult to imitate. A disadvantage is that if key people leave the company, this asset is lost and is difficult to replace quickly.

[3] A large part of the information in this chapter is taken from the book 'Managing Innovation' by Tidd, Bessant and Pavitt (Tidd, et al., 2005)

Lead Time

Lead time means introducing a product to the market that competitors have not yet developed and the time until a competitor comes to the market is called lead time. Time is an important appropriation mechanism, not only because a company can sell as a monopoly in this period, but it can also take a share of the market and people will connect the product to the company. The advantage is clearly the market share and profits that can be made. However achieving lead time is difficult, and usually involves other appropriation mechanisms (such as secrecy, because competitors will not know what the innovation is, or learning curve because the prior knowledge makes the process more efficient) which have their own disadvantages.

After Sales Service

After sales service is the help a customer is given after the product has been bought. This can be a helpdesk, updates, tips, etc. After Sales Service can be seen as a Marketing tool, rather than a protection of IP; however when combined with Lead-time advantage, this is a powerful tool, because the market share acquired by the lead time is sustained through After Sales Service. The advantage is that if a market share is established, the After Sales Service will sustain this, and can therefore be very profitable. However this mechanism depends on another mechanism (lead time) which itself is dependant on other mechanisms, so before this mechanism can be successfully used, a number of other conditions have to be met. Furthermore, if a better and cheaper product is introduced, especially in business-to-business, customer loyalty can disappear very quickly.

Learning curve

Learning curve means that the prior knowledge has made the process more efficient. The advantages are both the lower cost and the decreased time to market. This is quite similar to acquired tacit knowledge. The disadvantage is again that if key people leave, the learning curve advantages could disappear.

Complementary assets

Using complementary assets is another effective way of appropriating returns. This means that when a product has been acquired, a number of useful, extra products are offered to make the original product more desirable. This is also the way IBM was able to catch up in the PC market (Teece, 1986). The disadvantage are that this mechanism might be very easily copied, of none of the products are complex or secret.

Product Complexity

In certain industries a very effective way of avoiding imitation is the product complexity. The semiconductor industry is a good example of this, because high-tech, expensive devices are needed to reverse engineer semiconductor products. However this form of appropriation can only be used by companies in certain industries.

Standards

A highly effective (but risky) way of getting large returns on the investment in R&D is to make your product the standard. However competitors won't simply let you take the market, which can result in competition between standards. An example of this, is the fight over which type of videotape format would become the market standard. There were three types, namely VHS (created by JVC), Betamax (Sony) and Video2000 (Philips). The winner got the entire market and thus reaped the rewards of his innovation. However the losers, in this case Sony and Philips, were stuck with a useless system and have spent large resources on a product with zero commercial value.

Branding

Branding is an important way to appropriate returns from innovation. If the products are consistently of high quality, this will lead to credibility of the brand. Another aspect of branding is that it creates customer loyalty.

4.5 Trade-off Patents and Secrecy

In the previous paragraph, the different alternatives to patents were described. However not all options are as effective, and in different industries, there are different preferred appropriation mechanisms.

Most literature on IP protection (in high-tech) revolves around the trade-off between Patents and Secrecy, their individual benefits and the preference by firms. The trade-off between Patents and Secrecy is between

- Patents: Legal protection, but full disclosure of information
- Secrecy: No disclosure of information, but no legal protection

These two methods are mutually exclusive (Arundel, 2001) and has lead researchers to ask the question which method is more effective, and more valued by companies (Cohen, et al., 2000; T. C. Levin, et al., 1987). Secrecy is usually associated with lead-time advantage, which is also mentioned as an important appropriation mechanism.

Research shows that rather than small firms relying on patents, small firms in fact rely prefer secrecy (Arundel, 2001; MacDonald, 2003), as can be seen in Table 3. (See also Paragraph 3.3.2). This is an interesting finding, when comparing it to the VC's desire for patents.

TABLE 3: RELATIVE IMPORTANCE OF PATENTS AND SECRECY FOR ALL R&D-PERFORMING FIRMS (ARUNDEL, 2001)

Relative importance of patents and secrecy for all R&D-performing firms (standard errors in parentheses)

Employees	*N*	Product innovations			Process innovations		
		Patents more important	Equal importance	Secrecy more important	Patents more important	Equal importance	Secrecy more important
< 19	183	17.5 (2.8)	38.3 (3.6)	44.3 (3.7)	10.4 (2.3)	40.4 (3.6)	49.2 (3.7)
20–49	386	17.6 (1.9)	23.6 (2.2)	58.8 (2.5)	12.4 (1.7)	27.5 (2.3)	60.1 (2.5)
50–99	452	23.0 (2.0)	28.5 (2.1)	48.5 (2.4)	11.1 (1.5)	37.4 (2.3)	51.5 (2.4)
100–249	668	20.7 (1.6)	28.0 (1.7)	51.3 (1.9)	11.8 (1.3)	35.9 (1.9)	52.2 (1.9)
250–499	479	20.5 (1.8)	30.1 (2.1)	49.5 (2.3)	12.3 (1.5)	29.6 (2.1)	58.0 (2.3)
500–999	319	24.5 (2.4)	24.8 (2.4)	50.8 (2.8)	9.7 (1.7)	23.2 (2.4)	67.1 (2.6)
1000–1999	186	23.7 (3.1)	33.9 (3.5)	42.5 (3.6)	10.8 (2.3)	30.6 (3.4)	58.6 (3.6)
> 2000	176	30.7 (3.5)	26.1 (3.3)	43.2 (3.7)	19.9 (3.0)	23.3 (3.2)	56.8 (3.7)
Significance of the trend by size				$p < 0.0001$			ns

4.6 Summary and Raised Questions

This chapter reviewed the literature on the advantages, disadvantages and alternatives to Patents. This is an important theoretical background for the empirical research. This part of the thesis is concerned with why Venture Capitalists have a preference for Patents.

In this chapter we have seen that since the introduction of patents, the reasons to patents have increased in numbers. However with this strategic use of Patents, a number of disadvantages have also appeared. Besides these advantages and disadvantages, a number of alternatives have also been established, that have their own advantages and disadvantages, and dependant on the situation, can be a more useful appropriation mechanism than patents. What is particularly interesting is that small firms prefer secrecy to patents (Arundel, 2001).

The question that was posed at the start of this chapter was:

Why do Venture Capitalists prefer that the Small Semiconductor firms they invest in protect their innovations with Patents instead of other Appropriation Mechanisms?

With the theoretical background given in this chapter, a number of sub-questions can emerge that can help answer this question. Some sub-questions are:

- What Advantages of Patents are important to the Venture Capitalist?
- How do Venture Capitalists View the Cost of Patents?
- How do Venture Capitalists View the Information Disclosed in a Patent?
- How big is the Risk of possible Litigation?
- Why don't Venture Capitalists find Secrecy a better Alternative?

These are all questions aimed to clarify why Venture Capitalists want Patents, and will help answer the research question.

5 Methodology

The literature review has given a theoretical background of the topic, and the main research questions and related questions have been stated. Now the correct empirical research methods had to be devised, that can answer the research questions in the best way possible. In this chapter the research choices and justifications are discussed.

In this chapter an overview is given of the methods and justification of the methods to answer the research questions. This starts with paragraph 5.1, the Research Outline and Framework, which includes an overview of the research. In paragraph 5.2 the Research methods are discussed, which discuss the justifications of the different research methods.

5.1 Research Outline and Framework

This paragraph gives a brief overview of the outline of the research, followed by a research framework, which show how the research was conducted.

It is important to note that due to time constraints only Venture Capitalists have been interviewed for this research, and that the data offered in this research is purely from the Venture Capitalist Point of View.

Interview Schedule

The aim of this thesis is to explore the relation between Venture Capital and Patents. A broad number of aspects of this relationship have been explored, in order to get a comprehensive view of the relation. The aspects of the relation between Venture Capital and Patents that have been explored are:

- Selection criteria of VCs
- Benefits, Drawbacks and Alternatives to Patents
- Analysis of Patents
- Patent Litigation
- The Patent System

In-depth interviews were conducted with the participants on these issues. The Venture Capitalists were asked questions that allowed for elaboration, and were not Yes/No. Because these were in-depth interview, this questionnaire should be seen as an interview schedule rather than a questionnaire that simply ticks of the questions. Therefore from this point on, the list of questions that was used during the in-depth interviews will be referred to as Interview Schedule (See Appendix A: Interview Schedule)

The questions that were asked were composed in order to help clarify the topics. The questions in this Interview Schedule were composed with knowledge of the subject acquired from the

literature review. However these questions have not been tested asked before in other research, and therefore needed to be checked beforehand. They were sent to a Venture Capitalist that invests in the Semiconductor Industry, who checked whether the questions were relevant, and whether questions needed to be added. After some suggestions by this Venture Capitalist, the Interview Schedule that can be seen in Appendix A: Interview Schedule was used in the interviews.

Besides this pilot study, the Venture Capitalists that participated in the in-depth interviews were sent the Interview Schedule in advance, and were encouraged to add additional topics if this was found necessary.

Finding and Contacting Participants

After having the Interview Schedule checked, Venture Capitalists were contacted. The literature that was used, focuses on patenting in the United States, which is why Venture Capitalists in the United States that operate in the semiconductor industry were contacted. First twenty firms were contacted by phone, followed by email with details of the proposed interview. However only a few of these firms reacted, and none were willing to participate.

Finding Venture Capitalists in the US that would be willing to participate seemed to be difficult. Instead Dutch firms were contacted, with the hope that the fame of the Delft University name would help in getting interviews. Whether it was the name of the University that helped get the interviews is unclear, but three firms were willing to cooperate.

A list of the Dutch Venture Capitalists was found on the website of the Nederlandse Verenging van Participatiemaatschappijen (Dutch Private Equity & Venture Capital Association). Venture Capital firms that invest in the Semiconductor Industry were contacted, and three were willing to participate. However because of the lack of Dutch Venture Capital firms which invest in the Semiconductor industry, the scope was extended to include Europe.

Using the Snowball-Effect, other Venture Capital firms that invest in the semiconductor industry were located. In the Semiconductor Industry, Venture Capital investments are usually done by a number of Venture Capital firms. This is because the investment is large, and having Venture Capital firms invest reduces some of the risk. This means that a Semiconductor firm that has received Venture Capital usually has a number of investors. And every Venture Capital firm has a number of investments. So the way other Venture Capital firms were found, was looking on the website of the Dutch firms that had been interviewed. On the website the Venture Capital firms had the names of the (semiconductor) companies in which they had invested. The websites of these semiconductor firms were then visited, to see which Venture Capital firms had invested in them. Per firm, this usually gave three to four Venture Capitalists. These Venture Capital firms again had a list of Semiconductor Firms they had invested in, which again led to new Venture Capital firms.

This snowball effect of finding Venture Capital firms was quite effective, and a list of Venture Capital was composed, which consisted mostly of firms in the United Kingdom and also Germany, France, Israel and Scandinavia.

VC Companies in the United Kingdom were contacted first, because there would be no language barrier. Four UK based VC firms were willing to participate. Furthermore German VC firms were contacted, with a special consideration of those that employed Dutch employees. Two Dutch Venture Capitalists that worked for German Venture Capital firms were willing to participate. Of the other contacted VC firms, one Israeli firm was willing to participate. All put together, this led to 10 Venture Capitalists that were willing to participate.

Interviews

The Venture Capitalists that agreed to participate in the research were interviewed. One Venture Capitalist only agreed to reply to the questions of the Interview Schedule by email. The answers in the email were not in-depth and this showed that indeed in-depth interviews were necessary, because they allowed for follow-up questions. The answers in the email were clearly not of enough depth, and have not been included in the research.

Three of the in-depth interviews, with the Venture Capitalists located in the Netherlands, were conducted face-to-face. The others were conducted over the phone. During the interview, notes were taken. After the interview, these notes were worked out.

The information from the interviews was then restructured in a way that it would be clear how they answer the research questions.

Research Framework

The research framework gives an overview of how the research will be conducted.

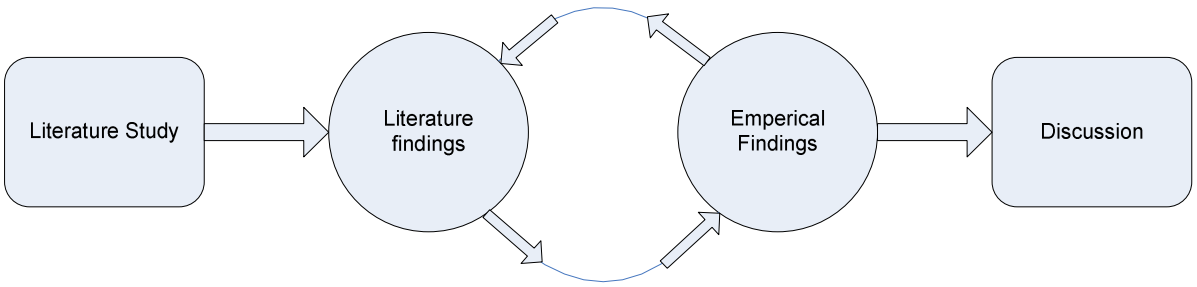

FIGURE 5: RESEARCH FRAMEWORK

5.2 Research Methods

The previous paragraph gave an overview of how the empirical research was conducted. This paragraph discusses how the different methodological choices were made, and why these choices were considered the best option to answer the research questions.

This paragraph is split up into three parts, namely the type of research that will be conducted, who the participants of the research are, and the methods of gathering the information.

5.2.1 Type of Research

To decide what type of research must be conducted, we must first look at the research questions and how these questions must be answered. The questions cover a rather broad topic and have the aim to explore the topic thoroughly. It therefore seems advisable to let the Venture Capitalists talk about the topics, rather than posing yes/no questions.

It also seems that this field of research has not been extensively researched (Haeussler, et al., 2009), which makes exploratory research the best option. The topic is ill defined and because the answers to the questions will probably need follow-up questions, qualitative research seems to be the best option (Ritchie & Lewis, 2003).

Qualitative research has the benefit of going deeper into the questions and being able to uncover issues that were not foreseen before the research. However as opposed to quantitative research, it is hard to make generalizations from this research.

The aim of the research is to provide more understanding on the role of patents in the Venture Capital decision to invest (in the semiconductor industry), a field that has not been studied extensively yet, which seems to make qualitative exploratory study the best option(Patton, 2002), even though generalizations can not be made from this research.

5.2.2 Data Collection Method

We now have determined that a qualitative study is the best way to explore the research that is to be conducted. Now the question is what data collection method should be used. When conducting qualitative research, the choice is between naturally occurring and generated data. This choice depends on whether the required data exists (Ritchie & Lewis, 2003). Since there is no data available (such as documents, interactions or settings) where the phenomenon is displayed, the data needs to be generated. The main types of generated data are in-depth interviews and focus groups.

The deciding factors for this choice between interviews and focus groups are *'the Nature of the Data Sought'*, the *'Subject Matter'* and *'the Research Population*' (Ritchie & Lewis, 2003).

From these topics it seems that in-depth interviews are the best option. The information given by the participants needs to be seen in perspective of their entire story in order to see the thread of the story. The issues discussed are quite multifaceted, and one of the major advantages of in-depth interviews (more than in focus groups) is the option to ask further questions on the topic and ask for motivations of decisions.

A more practical choice of in-depth interviews was the fact that the participants live in different countries and have a tight schedule; getting together a focus group, even on the telephone, seemed like a near impossible option.

Another consideration makes in-depth interviews a better option than focus groups. The Venture Capitalists wanted to remain anonymous, and not be quoted directly, because they do not want the competition to know their trade secrets. This is why during a focus group, where the competition is in the same room or on the same phone-line, the Venture Capitalists would probably not be as open and honest.

Although in-depth interviews are the preferred choice, it must be noted that there are risks to conducting in-depth interviews. The interviews need to be conducted in an objective fashion. There is always a chance that a bias of the interviewer will influence the results, especially since these interview scripts are not standardized (Seidman, 1998). The interviewer has tried to be as objective as possible in the interviews, in order not to influence the participants. However this can never be guaranteed, caution is needed when making firm empirical conclusions from the interviews.

Interview Schedule

These in-depth interviews are conducted using questions that can be seen in the Interview Schedule (See Appendix A: Interview Schedule). Because this is an unexplored field, there is no tested Questionnaire that can be used. The questions that were used were composed with the aim to clarify the different topics.

However because the researcher is not an expert in the field, these questions may not cover the topics fully, or may focus on the wrong topics. This is why the questions were sent to a Venture Capitalist that invests in the Semiconductor Industry. This Venture Capitalist had experience in investments and what role patents play, and has advised on the questions.

Furthermore, the Venture Capitalists were given the questions in advance, and were told to elaborate or discuss topics that were important. And most Venture Capitalists indeed drew attention to a topic they found important, or that was not mentioned before, which has improved the quality of the information

So although the questions were not taken from a tested questionnaire, they were reviewed by an experienced Venture Capitalist in the field who knew which topics should be covered, which suggests that the questions indeed covered the topics sufficiently.

5.2.3 Participants

The participants of this research have been chosen carefully. The aim of the research is the role of patents in a Venture Capitalists' decision to invest in a semiconductor start-up. The choice has been made to only interview Venture Capitalists. Time restrictions did not permit a wider view (which could include small firms), and the choice was made to only interview Venture Capitalists, because they can give a view of how important they find patents, rather than small firms patenting because they 'feel' it improves their chance of receiving VC.

The criteria that have been set up are:

- Venture Capitalist
- Invest in Semiconductor Industry

Once the criteria had been set, the Venture Capitalists had to be found.

The literature on this topic was mostly on the United States. This is why at first only Venture Capital firms in the United States were contacted. However after 20 had been contacted, and none were willing to participate, it was decided to interview Venture Capitalists in Netherlands and later Europe and Israel.

However the literature review on the patent surge in the semiconductor industry, focuses on the United States. It could be that Venture Capitalists do not care for patents as they do in the United States, and as a result small semiconductor firms don't patent more.

This has been noted and interviews with US Venture Capitalists would align better with the literature. However the results from this research are still interesting and still answer the research questions. The aim of this research is to clarify the relation between Venture Capital and Patents, whether this relation is strong or not. In this research, these results will apply to the European and Israeli Venture Capitalists, and not the American.

Since this research focuses on European and Israeli Venture Capitalists, these had to be found. In the Netherlands the website of the 'Nederlandse Verenging van Participatiemaatschappijen' (Dutch Private Equity & Venture Capital Association)) was consulted, which resulted in a limited number of Venture Capital firms that invest in the Semiconductor Industry.

Using the Snowball-Effect, other Venture Capital firms that invest in the semiconductor industry were located. In the Semiconductor Industry, Venture Capital investments are usually done by a number of Venture Capital firms. This is because the investment is large, and having Venture Capital firms invest reduces some of the risk. This means that a Semiconductor firm that has received Venture Capital usually has a number of investors. And every Venture Capital firm has a number of investments. So the way other Venture Capital firms were found, was looking on the website of the Dutch firms that had been interviewed. On the website the Venture Capital firms had the names of the (semiconductor) companies in which they had invested. The websites of

these small semiconductor firms were then visited, to see which Venture Capital firms had invested in them. Per firm, this usually gave three to four Venture Capitalists. These Venture Capital firms again had a list of Semiconductor Firms they had invested in, which again led to new Venture Capital firms. Using the snowball effect, there is a chance that the sample of interview participants will be biased (Seidman, 1998). This is why the search for participants was extended with internet search engines, where no new possible participants were found. Since only the internet was used for companies outside the Netherlands, there is chance of bias. However in the current technological time, it seems unlikely that a large group of possible participants has been excluded because they do not have a website.

This snowball effect of finding Venture Capital firms was quite effective, and a list of Venture Capital was composed, which consisted mostly of firms in the United Kingdom and also Germany, France, Israel and Scandinavia.

VC Companies in the United Kingdom were contacted first, because there would be no language barrier. Four UK based VC firms were willing to participate. Furthermore German VC firms were contacted, with a special consideration of those that employed Dutch employees. Two Dutch Venture Capitalists that worked for German Venture Capital firms were willing to participate. Of the other contacted VC firms, one Israeli firm was willing to participate. All put together, this led to 10 Venture Capitalists who were willing to participate.

In the end, only Dutch, UK-based, German and Israeli Venture Capitalists were interviewed. It could be that other European Venture Capital firms have different views on the relation between Venture Capital and Patents. However since most Venture Capital firms in the Semiconductor Industry invest in the whole of Europe (or even beyond), this seems unlikely. However it should be noted that the number of countries that the VC firms were located in, is limited.

6 Data

In this chapter the data gathered from the interviews is presented. This data was collected by interviewing 10 Venture Capitalists on relation between Patents and Venture Capital in the semiconductor industry. The different aspects of this relationship that were discussed are:

- Importance of Patents
- Benefits, Drawbacks and Alternatives to Patents
- Evaluation of Patents
- Infringement
- The Patent System

In this chapter the information has been re-organized to answer the research questions. In paragraph 6.1 an overview of the interviewed firms is given, with their preferred industries, and stage of investments. The names of the firms and participants have not been added for privacy reasons. In paragraph 6.2 the data gathered on the relation between Venture Capital and Patents seen as a selection criterion. In paragraph 6.3 the data gathered on why Venture Capitalists want patents is presented. Information that was found to be interesting, but did fit the storyline of the thesis, has been placed in paragraph 6.4.

The information is presented in the form of quotes. A topic is shortly discussed, followed by a number of quotes by the Venture Capitalists.

Semiconductor Industry

Before the results of the interviews are reviewed, a small description of the semiconductor industry is given, which shows the difference between sectors of semiconductor firms. This split is mainly important for the first category, on the 'Importance of Patents', not so much for the others. In this thesis the semiconductor industry is split into two categories, namely the fabless sector and the fab sector.

The fabless sector deals only with the research, design and development of semiconductor products and does not have a fabrication plant. Companies in the fab sector do have a manufacturing plant, and either only fabricate the semiconductor products, or also design them. The initial costs of a fabless company are much lower than that of a fab company and the number of fabless firms is also substantially higher than fab firms.

6.1 Venture Capital Firms

In this paragraph a list is presented with details on the interviewed firms. This list does not contain the names of the Venture Capital firms or the interviewed Venture Capitalists, for reasons of privacy. This list also serves as a reference for the quotes of the Venture Capitalists, which are used later on in the chapter.

The first subparagraph serves as a explanation for different aspects of the table which is presented in the second subparagraph.

6.1.1 Reference to Table

This paragraph gives a short description of the different columns of Table 4.

***Positions of Interviewee*:**
For the different positions within a Venture Capital firm, there are a number of different names for the same job. The most commonly used terms and their job description are explained here:

Associate:	'Researchers with the [Venture Capital] firm conduct extensive analysis that conduct extensive analysis of the industries related to any individual business proposal […] considered entry level venture capital jobs.' [4]
Senior Associate:	After having worked as an associate, it is possible to get a promotion to Senior Associate.
Principal:	Principal is the final stop before becoming a partner. The position of principal is usually given to a Senior Associate, or someone from outside the firm with experience in investment banking or management consulting.
Partner	Source Potential investment opportunities. Are usually only compensated for the investments they are involved in.

***Main industry of Investment*:**
This indicates in which industries the Venture Capital firm primarily invests. Most firms have either a global 'Technology' department of investment which also includes Semiconductors, or invest in specific industries such as the semiconductor industry.

[4] http://www.jobsearchdigest.com/private_equity_jobs/career_advice/about_venture_capital_jobs

***Stages of Investment*:**
This indicates which stage of investment the VC firm usually invests. The terms are again diverse, but generally the stages that are accepted are(Berghe & Levrau, 2001):

Early Stage
- Seed Stage
- Start-up Stage

Late Stage
- Expansion

'Seed money can be defined as financing provided to research, assess and develop an initial concept, before a business has reached the start-up phase.'

'Start-up financing can be defined as financing provided for product development and initial marketing or financing to companies that have completed the product development stage. These firms require funds to initiate commercial manufacturing and sales since they will not yet be generating a profit.'

'Expansion financing can be defined as financing provided for the growth and expansion of a company, that is reaching its breakeven point or already trading profitably. In this latter case capital may be used to finance increased production capability, market or product development, and/or to provide additional working capital. Expansion financing can also be made available to make the transition from being privately owned to being publicly quoted. Another possible type of expansion financing can be oriented to companies that cope with trading difficulties and hope to re-establish their competitiveness and profitability.'(Berghe & Levrau, 2001)

Current Number of Investments:
Number of companies the Venture Capital Firm is currently investing in. This is not limited to semiconductor firms they invest in, but all the firms the Venture Capital firms is currently investing in.

Current Fund Money:
The fund money is the money the Venture Capital firm is currently investing with.

TABLE 4: LIST OF DETAILS OF INTERVIEWED VENTURE CAPITALISTS

Reference Number of Quotes	Position of Interviewee	Country the VC firm is based	Main Industry of Investment	Stages of Investment	Current Number of Investments	Current Fund Money
A1	Investment Analyst *(Associate)*	Netherlands	Health care industry Services	Late Stage Growth Stage	* 5	€ 70 million
A2	Associate	Netherlands	ICT/Technology Clean Tech Life Sciences	Early Stage Late Stage	28	*€ 350 million
A3	Investment Manager *(Associate)*	Netherlands	No specific Industry	Late Stage	7	*€ 85 million
A4	Associate	UK	Technology Life Sciences	A and B round	77	*€ 900 million
A5	Associate	UK	Technology Life Sciences	Early Stage	78	*€ 910 million
A6	General Partner	Germany	Technology Life Sciences	Early Stage	52	€ 800 million
A7	Venture Advisor *(Senior Associate)*	Germany	No Specific Industry	Early Stage Late Stage	37	€ 400 million
A8	General Partner	UK	Technology	A-round	9	*€ 100 million
A9	Managing Partner	Israel	Semiconductors Communications IT Internet & Media Life Sciences	Seed Early Stage	47	*€ 550 million
A10	Partner	UK	Technology	Early Stage	62	£ 460 million

* An approximation has been made of the number of investments / Current Fund Money.

6.2 Patents as Selection Criteria

In the literature chapter 3, questions were raised were on the relation between Venture Capital and patents, where patents are seen as selection criteria. In this paragraph, the information gathered from the interviews on this topic is presented. The topics that are covered are how important patents are (also in relation to other selection criteria), if they are necessary in order to receive Venture Capital, and whether they advice them to patent. Finally the process of analyzing the patents is presented. The data is presented in the form of quotes of the Venture Capitalists. Each quote is followed by a number (A1 ... A10), which corresponds with the reference numbers in Table 4.

6.2.1 Importance of Patents

The first topic that is discussed with the Venture Capitalists is how important they find Patents in order to invest in a semiconductor company. The three sub topics were:

- How **important** are patents in the IP strategy?
- Are Patents a **necessity** to invest in a start-up?
- Would you advise a company to **file for a patent** if this was possible?

Importance

When asked about the importance of patents, the main issue that stood out was how important the context was around the patent. Only when other conditions were met, did IP play a role.

> *'The most important thing is the team, and the product, whether the product is different and has a market. If this is the case, only then do you look at the IP'. A2*

This being said, IP does play an important role. Even though it is only an issue after other conditions have been met, it does play an important role.

> *'We look for a defensible unique position. Patents can be a way to defend the unique position' A7*

> *'The whole IP strategy has to be solid. Just Patents is not enough; it is important what is patented, how much this protects the core technology, and how the rest is protected' A8*

So even though it is not the most crucial thing, IP is of big importance. And Patents do play an important role in this. However the Venture Capitalists do emphasize that the patents have to be of quality and protect the innovation, in order to be important:

'Patents are very important! Especially because they allow a Freedom-to-Operate; If the company does not have this freedom-to-operate, we would not invest. That is why patents are so important' A6

'Patents are not the most important thing, but it has clear benefits. What must be taken into account is the quality of patents as well. Just having patents is not good enough; the patent must protect the innovation.' A9

Most VCs agreed that patents are in one way or another important. However one Venture Capitalist did not think patents were so important. Although they allowed for Freedom-to-Operate, they were not considered a necessity.

'Patents are not that important. They allow a Freedom-to-Operate, but they are not a necessity, and if the product and team are good, and they have an IP strategy that does not include patents, this is not a problem. No Patents is an option.' A4

Necessity

So except for one Venture Capitalist, most Venture Capitalists did consider patents to be important. However the level of importance varied. The next question that was asked was whether patents were necessary for a firm to receive Venture Capital investment. Whether patents are necessary for investment sheds more light on how important they are. The questions were whether they considered patents to be necessary, and whether they had ever invested in firms that did not have patents.

'For Fabless Designers it might be possible, but they would have to have a very good story of why they don't have or need patents. For manufacturing start-ups patents are absolutely essential' A6

'If they do not have patents, we will sometimes even advise them to go to a business angel first. Probably they will need assistance in some areas, and it is to early for Venture Capital, but a business angel can be of great help.' A6

'If the IP protection strategy works without patents, this is ok, but it would have to be a very solid strategy.' A7

The same VC that did not find patents very important, (naturally) did not see them as a necessity

'No, they're not necessary. But a good IP protection strategy is necessary.' *A4*

These answers suggest that if no patents are present, there might still be a chance of investment. The next question was whether they had ever invested in a firm without patents.

'Not to my recollection' *A2*

'Not as far as I know' *A5*

Even the Venture Capitalist that did not consider patents to be that important stated:

'I can't remember a firm in the semiconductor industry we have invested in that did not have patents. However this would not be a problem if the rest of the company was promising.' *A4*

Although the Venture Capitalists state that they would perhaps invest in semiconductor start-ups without patents, the fact that they have never invested in a start-up without patents suggests that patents are indeed an important selection criterion for Venture Capitalists.

This being said, one Venture Capitalist gave an interesting quote.

'Patents are not a signal that a company is mature; however usually a good, experienced management team will have a promising new technology, which they have protected with patents. These things are usually related.' *A8*

This is an interesting insight, which suggests that perhaps there is an underlying relationship between investment and the presence of patents, rather then it being an important selection criterion.

Future Patents

Perhaps even more interesting were the answers to the final question on the importance of Patents. This question asked whether they would advise a company to patent an innovation if this was possible. Here (except for one) the answers were an overwhelming yes.

'Yes, if they have any innovations that can be patented, they should patent it' *A9*

'Once we have invested, one of our investors goes in the board of the company. This person will also push the company to patent their innovations.' *A6*

6.2.2 Analysis of Patents

The previous sub paragraph shows how Venture Capitalists view patents as a selection criterion for investment. The Venture Capitalists also mentioned that not just the existence of patents was important, but the quality of patents. The venture Capitalists were asked how these patents were evaluated. Here the whole process of evaluation of the company was often mentioned, because the patent analysis is part of the whole analysis. An important aspect in the first stages of analysis of the company was the informal network (More on the informal network in paragraph 6.4.2):

> *'We usually contact someone from our informal network, who has expertise in this specific sector. For instance an ex-ceo of a company we invested in, who is in the same sector. They can tell us about the technology' A2*

After certain stages have past (talking to team, reference calls, checking the documents supplied, etc.) and the Venture Capitalist is still interested, a due diligence is conducted. In this due diligence, the patents are checked thoroughly, and most VC firms use a company to check the patents.

> *'Patents are thoroughly checked during the due diligence. We hire an expert in this matter to check the patents. [...].They analyze whether the patent fully protects the product' A2*

> *'Yes, checking the patents is very important. We sometimes spend up to 50.000 on a patent check.' A6*

> *'Most Venture Capitalists that work in this company are managers and bankers. That is why we would hire experts to analyze the patents' A5*

Again the VC that did not find patents important also did not analyze patents thoroughly.

> *'Patents are not analyzed thoroughly. A better look is taken at the technology itself,' A4*

What is checked?

Since some of them had alluded to this, the Venture Capitalists were asked what the patents were checked for.

> *The most important issue in checking patents is that they allow for Freedom-to-Operate. The protection is also important, but Freedom-to-Operate is much more important.' A6*

'The first matter is how well the patent protects the innovation. Freedom-to-Operate is the next important issue. However this is harder to check, because you have to check all other patents that your patent might be infringing. Then in how many countries it applies, whether it easy to invent around are also important issues. We get a report from the expert we hire, which has a number of 'red flags' on risks in the patent.' *A2*

'- Does the patent stand up against prior art?
-Does it allow the company to do what it wants to do.' *A9*

So most importantly, the quality of the patent must be adequate. This quality is most significant in two areas, namely how well the patent protects the innovation, and whether the patent allows the company freedom to operate. The Venture Capitalists did not agree on which of these two was more important.

6.2.3 Summary

This paragraph shows that although patent are not the first priority of Venture Capitalists, they are considered important. The answers on whether they are necessary in order to receive Venture Capital were not conclusive, but the fact that most had never invested in a firm without patents, and the other could not recall having invested in a firm without patents is striking. Furthermore, the fact that once the Venture Capitalists had invested in a firm, they would advise the firm to patent is further proof that patents are important.

Because patents are considered important, the analysis of patents is also of importance. Most VCs start by using someone from their informal network. However in the due diligence, most hire outside experts. Most important to check are considered how well the patent protects the product, and whether it allows freedom-to-operate. There is no consensus on which is more important. What they do agree about is that it is much harder to check for Freedom-to-Operate, than it is to check how well the patent protects the innovation.

An interesting insight by one Venture Capitalist was that there was perhaps a relation between the quality of the team, and the presence of patents (i.e. a good team would probably protect innovations with patents, and thus patents themselves are a selection criterion).

The data shows that patents are definitely important to VCs. Perhaps there is an underlying relation between patents and investment, but the fact that once Venture Capitalists have invested, they will push the start-up to patent, and the investments made to check patent show that patents are indeed important.

6.3 Why Do VCs Want Patents?

In the literature chapter 4, questions were raised on why Venture Capitalists want patents. In this paragraph, the information gathered from the interviews on this topic is presented. The topics that are covered are how Venture Capitalists feel about alternatives to patents, how they view drawbacks of patents, and what they consider benefits of patents.

6.3.1 Alternatives

When asked about alternatives to patents as good appropriation mechanisms, secrecy was mentioned most. This was mostly because it is difficult to reverse engineer semi-conductor products.

> *'Secrecy is a good alternative. Best would be, and patents, and secrecy, and lead time advantage...' A2*

> *'If the patent can be invented around easily, than secrecy would be a good option' A10*

One VC even said:

> *'Trade Secret is a good option. The benefit of trade secret is that when you're infringing, since you are not willfully infringing, you will only have to pay a license fee, if they ever find out' A4*

Lead-time was also mentioned alongside other options.

> *'If you have a 1-2 year head start, you can take a large market share.' A7*

> *'Execution of the company is important. If you are going into an industry with no innovation, the execution of the company came make a big difference' A5*

So the most important alternative that is mentioned is secrecy. Furthermore, lead-time advantage is also seen as important. Some other options were also mentioned, but specifically secrecy, and to some extent also lead-time advantage, were certainly the most important alternative appropriation mechanisms.

6.3.2 Downsides of Patents

When asking about downsides of patents, the focus was on the disclosure of information, cost and infringement. However VCs did not view any of these as large drawbacks.

> *'Because of the large number of patents in this industry, the information given away in a patent application is not critical'* *A8*

> *'Because of the complexity of the innovation in the semiconductor industry, information does not have to be given away. If you have an experienced firm filing the patent, it is possible to have a very broad protection, without given away the key information'* *A6*

> *'Sometimes it is possible to patent without giving away important information. However this is not always possible, so sometimes information is made public. But still this is not a big problem.'* *A9*

The disclosure of information was not considered a big threat. Even less important are the costs of the patent

> *'With the money we invest in a company, the cost of patents are not very high. And they serve as a hard guarantee for us.'* *A2*

> *'Money is definitely not an issue when considering patents. If you compare it to our other investments, it is not very big.'* *A8*

The cost of a patent is also not a deterrent for VCs. Because of the high costs of the semiconductor industry, the cost of patents is seen as not very significant.

The few downsides that were mentioned:

> *'The focus of the team and the time lost in patenting process.'* *A4*

Infringement

Lawsuits are always expensive, and if a start-up enters an infringement lawsuit, this is just money down the drain for the Venture Capitalist. The Venture Capitalists were asked about the risk of infringement (infringing and being infringed) as a downside of patents. This was not considered a big fear or downside.

> *'No, we do not worry about infringement lawsuits'* *A1*

The Venture Capitalists were then asked what they're action would be if there was infringement. First the issue of their firm's patent infringing another patent was discussed.

> *'First we will analyze the claim. Depending on the seriousness of the claim we will proceed. If the claim is frivolous, we will fight the claim. If the claim is completely valid, which doesn't happen often, because we did a risk analysis, we will determine what the cost will be. If the cost is higher than the expected gains of the company, we will no longer invest. However mostly it is not clear how valid the claim is; we will analyze it, and depending on this analysis, either settle or go to court'* *A9*

> *'I have been burned a few times with lawsuits, and a lawsuit means burning money and time of the team. The first thing we do is analyze how and if we are infringing. If this is the case, we will always try to settle.'* *A6*

Most Venture Capitalists had the same approach in case their firm's patent was infringing, and they were being sued. The first thing that was done was assess the merits of the claim. This would result in one of three situations:

1) The claim is frivolous, in which case the start-up will fight the claim, with the help of the Venture Capitalist.
2) The claim is completely valid, in which case a settlement would be the best option. In this negotiation the start-up will also be assisted by the Venture Capitalist. If the other company is not willing to settle, a lawsuit will follow, in which case the Venture Capitalist will assess the situation and if it seems profitable, assist the company legally.
3) The claim is partly valid (most common) in which case negotiation is the best option, and if the other company is not willing to settle, a lawsuit will follow in which case the Venture Capitalist will assess the situation and if it seems profitable, assist the company legally.

When the claim comes in, the company assesses the claim. The next thing the Venture Capitalist will do is assess the situation, as described above. If it seems that the costs of the lawsuit are high and the financial future of the small semiconductor company doesn't look positive, the Venture Capitalist will stop investing.
Without a single exception, each Venture Capitalist has said that if it seems the company has a commercially positive future, they will help the best they can in every possible way.

> *'We will help the company any way we can. We have contacts with law firms with which we can bring the firm in contact; we have a network of experts, our own expertise. It could be a critical situation for a firm, and we will help them any way we can'* *A1*

> *'Usually with expertise and our network'* *A3*

Being Infringed

Another possibility is that a patent of the small firm is being infringed. Here different tactics are used to deal with this situation.

If a patent of the firm is being infringed, and this infringing firm operates in the same market as the small semiconductor firm, they would contact the infringing firm, and ask them to cease the commercialization of this innovation.

> *'If the other (infringing) firm is a direct threat to the market of our firm, contact the company.'* *A3*

> *'Ask them to cease and desist. If they refuse, take them to court'* *A5*

However if it the infringing firm is not operating in the same market, it is not seen as a big issue, and sometimes it is considered that not suing them is the better option.

> *'The threat of suing is countersuits. So if there is no threat to our market, we will often leave it'* *A9*

> *'If the firm does not operate in our market, we will often not even contact them.'* *A8*

One Venture Capitalist even said

> *'We will leave it for a while. If it turns out that the other company is making a profit with our patent, we can ask for a percentage of the profit.'* *A7*

If the one of the start-ups patents is being infringed, this is not necessarily a bad situation. Another analysis of the situation is made, in which two scenarios can happen:

- The infringing firm operates inside the start-up's market
- The infringing firm operates outside the start-up's market

In the first case the Venture Capitalist will immediately advise the start-up to send a letter to the other firm to cease their activities or they will sue. If the other firm refuses, the start-up is advised to sue.

If the other firm doesn't operate in start-up's market, things are not very critical. Different Venture Capitalists have different views on this issue.

One of the dangers of suing a firm for infringement is the chance of a countersuit. Because of the cumulative nature of the industry, and the large number of patents, the other firm could

make the case that the start-up is also infringing their patent, which could result in an expensive lawsuit. Looking at the history of a firm to see the number of lawsuits can help determine how likely a countersuit is. This means that sometimes, even though the patent is being infringed, doing nothing is the best option.

6.3.3 Benefits

The next item was the benefits of patents. The two issues that were discussed most were the protection and the Freedom-to-Operate.

> '*Patents provide a black and white guarantee. Usually production is outsourced to the East (e.g. China). Patents provide a protection against copying*' *A2*

> '*90% of our patent check is whether it allows freedom-to-operate. This is the most important thing. The other 10% is protection*' *A6*

> '*Protection and Freedom-to-Operate are about 50-50. But it is much harder to check for Freedom-to-Operate*' *A8*

Other benefits that were mentioned were

> '*A patent allows a company to put a premium price on the product*' *A5*

> '*In negotiations (regarding patents and legal property rights) patents can be very important*'. *A7*

> '*In a licensing business model, obviously patents are very important*' *A4*

These benefits are all very straight forward. The benefit that was stressed most (besides protection and freedom-to-operate) was the value of patents during an exit. It was said that currently a Trade Sale was much more common than an IPO (Initial Public Offering).

> '*There used to be some IPOs, but nowadays it is almost exclusively trade sales*' *A1*

> '*IPOs have declined in recent years; strategic sale has become more important.*' *A3*

> '*IPOs are ideal because they raise more money. But there are much more Trade Sales*' *A10*

The importance of patents during an exit (usually trade sales) was strongly emphasized, when asked about this. The question was whether patents had any other benefits (besides protection), such as the value during the exit

> *'Of course! We have a company now with 50 patents, and 30 more pending. This will be of enormous value in trade sale.'* *A6*

> *'Patents also increase the value of the company.'* *A5*

> *'Patents are important to the large company. They use them in their licensing negotiations. But also, it is for them something tangible. The team could leave the company, but the patents are theirs.'* *A10*

One Venture Capitalist did not see patents themselves as the main reason for a higher price

> *Patents do not directly influence the value of company. The Defensible Unique position is important, not the patents specifically.'* *A7*

6.3.4 Summary

In this paragraph we have seen that patents are valued by Venture Capitalists for a reason. Alternatives that are considered valuable are mostly secrecy. However it is also mentioned that secrecy and patents can be combined.

The lack of downsides is probably the most striking. Cost is not considered a downside at all. Disclosure of information is to a small extent a downside, but also not considered very important. Although a lawsuit is said to be a waste of money and time, the risk of a lawsuit because of patents is also not a worry.

The benefits are mostly the protection of the product, and the freedom-to-operate. There is no clear answer on which is more important, but it is clear that these are the most important benefits of patents. Other benefits include the premium price of a product that is protected by a patent, the stronger negotiation position, and in case of a licensing business-model.

An important benefit which is specifically of importance to the Venture Capitalist, is the value of patents in an Exit. Patents are considered by most Venture Capitalists to be of importance during and IPO or Trade Sale, and increase the value of the small firm.

6.4 Other Findings

In this paragraph the information gathered in the interviews that does not directly relate to the research questions is reviewed. These are the patent system itself, on which questions were asked. The other topic of interest is the informal network. There is very little information on this informal network, but the Venture Capitalists themselves described it as being one the most important things of their company.

6.4.1 Patent System

When discussing the patent system, it is important to note that we mean the patent system as a whole. So in this segment, when speaking of advantages and disadvantages of the patent system, the advantages and disadvantages to society or the industry are meant, not the advantages and disadvantages of having a patent, as discussed in the previous chapters.

A famous, and often repeated, quote on the patent system is

> *"If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it."(Machlup, 1958)*

There is some literature that claims that patents actually deter innovation, rather than spur it on. In this research the focus was on whether patents deterred small firms in their innovation, and whether the patent system was beneficial for small firms.

In the interviews, the Venture Capitalists were asked about their opinion of the patent system, and what effect it had on innovation and small firms.
It was clear from the answers of the Venture Capitalists that they had not really thought of this question before. They did feel that for small firms, patents were beneficial, mainly because it allows for investment in the industry. However it did not become clear whether small firms have to deal with licensing agreements, which might be a detriment to the company.

> *'If the patent system was abolished, investors would probably go to less capital-intensive industries such as software or services. Semiconductor start-ups would not get much Venture Capital anymore.' A5*

> *'If there were no more patents, much less money would go to semiconductor start-ups. This would make the industry more efficient, a lot of money is being wasted. But there would definitely be much less innovation, because fewer companies would be financed.' A10*

'There are problems with the patent system, such as patent trolls (companies that patent, wait until someone infringes the patent, and then claim a part of the profit)*. But abolishing the patent system would not be good for the industry.'* *A7*

'The patent system and the large number of patents are actually beneficial to the small firms. They can license certain innovations without having to do it themselves.' *A4*

The answers given by the Venture Capitalists suggest that they don't feel that patents should be abolished. Patents allow for investment in the industry, which is of course a very important issue for any industry. Without investment, the innovation in an industry would plunge.

Another possible downside of the patent system for small firms are the large number of patents owned by large firms, and subsequent need to license-in patents. Because large firms own so many patents, and it is a cumulative industry, chances are that an innovation will use innovations patented large firms. Large firms are in a position to ask outrageous prices for these licenses, which would hinder innovation by small firms. However the Venture Capitalists did not see this as a downside.

'Small firms do not have to deal with cross-licensing agreements. Only when they're profitable will they need to license. And in the semiconductor industry a firm is usually bought before it becomes profitable.' *A9*

'Patents also allow for alternative business models such as licensing-out.' *A5*

'Small firms cannot enter the market as they please, because Qualcomm holds all the important patents. The most they can hope for is to go in a niche, and license the patents from Qualcomm, which is expensive.' *A10*

The answers given by the Venture Capitalists suggest that they don't feel that patents should be abolished. Patents allow for investment in the industry, and licensing is not a problem.

Most Venture Capitalists do however feel that the patent system could use improvements.

'There are so many patents that are frivolous; there should be stricter rules on what can be patented.' *A8*

'If you look at what is being patented, it is unbelievable. A patent should be innovative and non-obvious. If you see the sort of things that are being patented' *A7*

'The regulators should be better educated. They don't know the industry, and yet they are making rules that apply to the industry.' *A10*

So although the Venture Capitalists feel that the patent system is important for small firms in the semiconductor industry, specifically because it allows for more investment, they also feel certain aspects should be changed, and that regulators should be educated better.

6.4.2 The Informal Network

The informal network was already discussed shortly. However it was striking to note that every Venture Capitalist put such emphasis on the informal network, and bring it up without being asked about it. This topic was followed, and the importance of the informal network was asked:

'Yes, the informal network is very important. It is not different from an informal network in other industries (than VC). Contacts and business acquaintances, such as ex-CEO's or lawyers we've worked with.' *A3*

'Because every company we analyze has a new product that is totally new, we can't be experts. And since most Venture Capitalists here are managers or bankers, we need technical expertise. We ask one of our acquaintances that knows something about that specific sector to check whether the product is indeed valuable.' *A7*

'It is a two-way street, so when someone from our informal network asks us for some information or help, we will help them as well. The informal network is very important to us, so we maintain the relationships very seriously.' *A1*

'For the person in the informal network we ask, this also has a benefit. It is good for them to know what is on the market, so when they analyze a new firm, they know what is happening in the sector.[...]. If we feel that the company needs extra personnel, for instance a new CEO, people from our informal network are contacted.' *A6*

One of findings of this research that was unexpected was the importance of the informal network. This informal network is supposedly no different from any company's informal network that is built through business relations and employee's relations before transferring to the Venture Capital firm. However its significance is much larger in Venture Capital firms.

7 Conclusion

This thesis is aimed at exploring the relation between Venture Capital and Patents. Two research questions have been composed that will help clarify this topic. In chapters 3 and 4 a theoretical background on these topics was presented in, which resulted in a number of sub-questions. In chapter 6, the data acquired during the empirical research was presented, which consists of information that will answer the research questions. In this chapter this data is discussed and compared to the literature, and the research questions will be answered.

The first paragraph 0 discusses the research question and aims to answer it. This is followed in paragraph 7.2 by relating the results to the current literature. This thesis has also resulted in findings that can be used in practice. Suggestions for practical implications are discussed in paragraph 7.2. Finally in paragraph 7.4 suggestions for future research on this topic are suggested.

7.1 Discussion of Research Questions

This thesis is aimed at exploring the relation between Venture Capital and Patents. Two research questions have been composed to help clarify this topic. Data was then gathered to help answer these research questions. This paragraph discusses the found data to help answer the research questions.

7.1.1 Research Question 1: Patents as a Venture Capitalist's Selection Criterion

Literature on the Venture Capitalists' Selection Criteria showed that Patents are not mentioned often as a Selection Criterion by Venture Capitalists. However Research by Hall & Ziedonis (1999, 2001) revealed that small US firms in the semiconductor industry patented in order to receive Venture Capital. This seeming paradox was the starting point for the exploration of the relation between Patents and Venture Capital.

The first research question that was posed in order to clarify the relation between Patents and Venture Capital in the Semiconductor industry was:

What is the role of Patents as a Venture Capitalist's Selection Criterion for Small Firms in the Semiconductor industry?

The literature on this topic is limited. The literature on Venture Capitalists' Selection Criteria focuses mainly on the Management Team and Product (Chao-wen Mu, 2007). The little research that has been done on the relation between Venture Capital and Patents is mainly quantitative (Haeussler, et al., 2009; Hsu & Ziedonis, 2007). This quantitative research shows that the value

of small semiconductor firms rises with the increase of number of patents, but an in-depth analysis of the relation is not given.

This thesis has researched this relationship by interviewing 10 Venture Capitalists on this relationship. These interviews gave information on different aspects of the role of patents as selection criteria.

Findings

In the questions on the importance of Patents as a Venture Capitalists' Selection Criterion, the Venture Capitalists emphasized strongly that the first thing they look for is a Sustainable Competitive Advantage. They first look at the Team, the Product, and the potential Market. Once they feel these conditions have been met, they look at the IP protection strategy, which has to be solid. After emphasizing this, they did mention the importance of Patents.

The next question was on the necessity of patents in order to receive Venture Capital. This shed more light on the importance. Most said that probably, or usually patents were necessary, and one Venture Capitalist stated that if a firm did not have patents, they would have to have a very good reason and IP protection strategy in order to receive Venture Capital. Furthermore, none of them could recall ever having invested in a firm without patents.
Finally the question was asked whether the VC would advise the firm to patent innovations, if this was possible. Except for one Venture Capitalist, they others answered with a resounding yes.

The analysis of the patent quality was also interesting. Initially a patent would be superficially checked by someone from the informal network. However by the time of the due diligence, an expert was usually hired to check the patents. Protection of the innovation, and Freedom-to-Operate were considered very important aspects of the selection. One Venture Capitalist even said that a thorough check of a company's patents could cost up to €50.000. This shows how serious the Venture Capitalists are about the quality of the patents.

Analysis

These findings show that although emphasis of the Venture Capitalists' Selection is on the Sustainable Competitive Advantage, the importance of Patents should not be dismissed. The literature mostly mentions the Management Team and the Product (and the Market) as the most important selection criteria (Chao-wen Mu, 2007). And previous research on the selection criteria mostly focuses on these issues. In this thesis the Venture Capitalists also emphasized the Management Team and the Product as being the most important. Only then was IP protection

mentioned. Here most Venture Capitalists stated that a solid IP protection is necessary, and should consist of more than simply patents.

Most Venture Capitalists do consider patents to be a necessary condition in order to invest, and even more striking is the fact that no Venture Capitalist could recall having invested in a firm that did not protect its innovations with patents. The expensive analysis of the patent portfolio is a confirmation of the importance of patents, which for one Venture Capitalist was $50.000 for the analysis of the patents of one firm. These large costs show that patents are taken very seriously; this suggests that patents are indeed an important aspect of the start-up.

These results could suggest that Patents should be seen as a Secondary Selection Criterion. The Venture Capitalists' selection process does not happen instantly on the basis of all information, but is a gradual process that happens over time. Patents are a selection criterion that is only analyzed later in the process during the due diligence. The first selection criteria (team, product, market) must be met first. When these are deemed sufficient, only then will patents be observed. This does not mean that patents are not important, but simply that if the first criteria are not met, there is no use in spending money on an analysis of the patents.

It must be noted that it is likely that there is a relationship between a solid, experienced management team, and the presence of patents. An experienced management team knows to protect its innovations with patents, so the presence of patents in a company with an experienced management team might not be entirely random.

7.1.2 Research Question 2: Why VCs want Patents

The second research question focuses on why Venture Capitalists view Patents as important Selection Criteria. There are a number of benefits associated with patents, however there are also a number of drawbacks and alternatives to patents.

The second research question that was posed in order to clarify the relation between Patents and Venture Capital in the Semiconductor industry was:

- ***Why do Venture Capitalists prefer that the Small Semiconductor firms they invest in protect their innovations with Patents instead of other Appropriation Mechanisms?***

Analysis

The Venture Capitalists paint a very clear picture of the benefits and drawbacks of patents for small firms in the Semiconductor Industry. Drawbacks described in the literature, such as Cost (Mulder, 2006), Infringement (Kingston, 2001) or information disclosure (Harabi, 1995) were not seen as important, or as big risks.

Although the answers seem plausible, it is not certain that what the Venture Capitalists claim, is what in reality happens. It could be that they know Patents are important, however the benefits and drawbacks have not been objectively compared to see what the real value of patents are. This analysis focuses on answering the research question, but also focuses on whether the answers seem plausible.

The Venture Capitalists stated that the cost of patents are not significant compared to other investments needed in the company. This seems plausible, because of the high investments needed in the semiconductor industry.

Another risk that was not seen as a large threat was the risk of infringement lawsuit. This was partly because of the check carried out by a professional company that analyzes risks. But as the Venture Capitalists stated, once this analysis has been carried out, there is not much more that can be done to reduce risk.

Finally the disclosure of information in the patent application. Two reasons were stated why it is not very risky to disclose the information in the patent application. The first was the large number of patent applications in the industry. It would therefore be difficult to find a single patent. Furthermore, some Venture Capitalists stated that it is in fact possible to file for patents without disclosing 'the magic ingredient' i.e. the important aspects that make it replicable. These statements seem somewhat less plausible. It seems that competition will look quite specifically in a certain area of innovation, and thus finding competitors' patents will not be extremely difficult. The claim that it is possible to patent an innovation which provides broad

protection without disclosing the critical information is difficult to assess, and not all Venture Capitalists agree. This should be investigated further.

The benefits associated with Patents were considered important. The Protection and Freedom-to-Operate that Patents provide were considered very important. Furthermore, the value increase associated with Patents is important.

When people are asked about the benefits of patents always reveals that the most important benefit of patents is the protection it offers. However an extensive study by Cohen (2000) revealed that in the semiconductor industry in only 26.67% of product innovations and 23.33% of process innovations, patents were considered the best appropriation mechanisms. However in small firms this might be different, and patents might actually be important.

The increased value of a firm in a Trade Sale[5] or IPO[6] was also mentioned as an important benefit of patents. This seems very plausible, because the only way Venture Capitalists make money is by having a successful exit.

The Venture Capitalists were very adamant that patents are definitely of great value, and if possible, patents applications should be filed. The absence of drawbacks, and important benefits were stated as the reason, which overall seems plausible. Not all answers are as plausible as others, but overall it seems that the Venture Capitalists indeed see no important downsides to patents and that the benefits to Venture Capitalists are of major importance.

[5] Trade Sale: Selling the company to a Strategic Large Partner
[6] IPO: Initial Public Offering: When the stocks of the company are sold publicly (on the stock market)

7.2 Relation to Literature

In this paragraph the findings of the thesis are compared to current literature on the topic, to see whether additions can be made to the literature.

VCs' Selection Criteria and Small Firms Patenting

This thesis started by comparing two pieces of literature. The first one was research in which small firms stated that they patented in order to receive Venture Capital. The second was the literature on Venture Capitalists' Selection Criteria, which seldom mentioned patents.

This thesis researched this topic, and the answer is rather satisfying, because it seems to explain this seeming paradox. This thesis shows that Venture Capitalists look at patents only at a later stage of the selection. The first selection criteria are not patents, but rather Management team or the market, which are also the main issues covered in the literature on Venture Capitalists' Selection Criteria (Chao-wen Mu, 2007). However once the primary selection criteria have been satisfied, patents do play an important role, and are important to the Venture Capitalists. Small firms in the US stated that they need Patents in order to receive Venture Capital (Hall & Ham Ziedonis, 2001). This research showed that in Europe small firms indeed also need patents in order to receive Venture Capital. So because Patents are only analyzed at a later stage of the selection process, they are not mentioned in the literature on the selection criteria, but because they do matter, small firms find that they need patents in order to receive Venture Capital. Patents are a secondary selection criterion, which is analyzed after the primary selection criteria have been satisfied.

Benefits and Drawbacks

The answers to the second research question were quite remarkable. In the literature, the benefits and drawbacks of patents are described extensively (Cohen, et al., 2000; Grandstrand, 1999; Harabi, 1995; Kingston, 2001).However this thesis showed that Venture Capitalists see no real downsides for firms in the semiconductor industry. And the benefits are also very specific. This thesis shows that the benefits and drawbacks vary per industry and per viewer, and that not every benefit or drawback is as important. This thesis showed that in the semiconductor industry, the drawbacks could be of minor importance.

What is also important is that these were Venture Capitalists. Therefore the value of the company is of major importance, which is why the increased value of the company associated with patents is so important. This thesis shows that the benefits and drawbacks of patents are applicable to every industry, and every stakeholder, but that every industry and stakeholder has a different take on the matter.

Patents and the non-disclosure of Information

In his 2001 article, Arundel (2001) states that Patents and Secrecy are mutually exclusive. He does suggest that both these appropriation mechanisms can be used in different stages of development, but not at the same time. However in this thesis some of the Venture Capitalists stated that it is possible to apply for patents without giving away critical information. Although this claim should be researched further, it is striking and could be of major importance to the literature on the benefits and drawbacks of patents, and the essence of patents, because it changes the whole perception of the situation in which patents and secrecy are mutually exclusive.

It is also important for the discussion of the patent system as a whole, and its benefits to society. The discussion of whether the patent system is still useful is still raging (Heller & Eisenberg, 1998; MacDonald, 2004; Stiglitz, 2006) and if it is indeed possible to file for patents without disclosing the critical information, this should be taken into consideration.

7.3 Implications of Research

This thesis resulted in some interesting findings on the relation between patents and Venture Capital. These results were mainly aimed to add to the current literature. However the results of can also be of use in practice. This paragraph discusses in short what the implications could be for different private parties (called management implications) and for policy makers.

7.3.1 Management Implications

The results of this research show that indeed Venture Capitalists find it important that firms protect their intellectual property with patents. However simply protecting intellectual property with patents is not enough. It is important that the patents are of sufficient quality, so that it broadly covers the innovation, and is not easy to invent around. Important are how broad the innovation is protected, and that it provides Freedom-to-Operate. Having a patent drafted by a professional firm might cost money now, but will save money in the long run.

It is even mentioned that it might be possible to patent innovations without giving away critical information. Specialized firms that draft patents will be able to allow for broad coverage, and keeping the disclosed critical information to a minimum. Therefore small firms and incubators helping small firms should very much consider an expensive patent drafter, because a strong patent protection is important to the Venture Capitalists.

7.3.2 Policy Implications

When discussing the patent system as a whole, the two most mentioned issues were the large number of patents, and the rules that did not met the demands of the market. The Venture Capitalists felt that there were too many frivolous patents that clogged up the system. They also felt that regulators did not know the industry, yet where making the rules. A discussion with the representatives of the stakeholders could perhaps lead to better regulations, which could help the whole industry.

7.4 Future Research

This thesis has revealed some interesting findings. However it has also left questions that could be researched and might result in some interesting findings.

Quantitative Research

This thesis was aimed at exploring the relation between Patents and Venture Capital in the Semiconductor industry. This was done by interviewing 10 Venture Capitalists. This qualitative research has given in-depth insight to the matter, but needs to be supported by quantitative research. This includes researching whether patents are really secondary selection criteria, how many semiconductor firms received Venture Capital and what percentage had patents. Furthermore the claim that there are no downsides to patents in the semiconductor industry can be researched, and the value of patents in a Trade Sale or IPO.

Quantitatively testing the results from this thesis would make the results much more robust and give a better view of the relationship between Venture Capital and Patents in the Semiconductor industry.

Disclosure of Information

An interesting finding in this thesis that needs to researched further is the claim that it is possible to be granted a patent that offers broad legal protection, yet does not have the critical information needed to replicate the innovation.
In the literature it was stated that patents and secrecy are mutually exclusive (Arundel, 2001), which also seems to be a logical conclusion, based on the characteristics of patents and secrecy (disclosure + legal protection vs. secrecy + no legal protection). It would be interesting to interview Patent Attorneys, Patent experts, etc. to see how true this is, and on what occasions this is possible.

If it is true that it is possible not to disclose the critical information and yet be given a broad legal protection, this has implications for society as well. Originally patents were introduced as a contract between society and the inventor. The inventor would receive a monopoly on his invention, while society got innovation and information from the innovation (Mazzoleni & Nelson, 1998). However if patents are filed that have a strength in court, yet do not disclose information, the contract between society and innovation is not kept. There is already literature on the fact that society is not gaining from patents (Heller & Eisenberg, 1998; MacDonald, 2004); the non-disclosure of information could be used in the research on whether the patent system is beneficial to society.

Small Firms

The time constraint of this thesis has limited the empirical research to only Venture Capitalists that were interviewed. However because of this, the side of the small firm is not heard. Research has shown that in general, small firms prefer secrecy over patent (Arundel & Steinmueller, 1998), yet small firms patent in order to receive Venture Capital (Hall & Ham Ziedonis, 2001) (in the US). It was assumed in this research that the small firm and the Venture Capitalist had the same goals and that the Venture Capitalist did not take actions that were disadvantageous to the small firm.

However this does not have to be true. The Venture Capitalist is mainly interested in getting a high rate of return on his investment. This might be achieved with patents; the management team of the start-up might not feel that patenting every innovation is the best action for their company.

Furthermore, as Hall & Ham (2001) state, small firms patented in order to receive Venture Capital, and this thesis showed that patents are indeed important. This means that small firms are forced to patent their innovations if they want to receive Venture Capital. And thus a significant amount of the start-ups resources must be directed towards acquiring patents, in the hope that they will receive Venture Capital.

Usually small firms and Venture Capitalists do not have exactly the same goals for the company, and it would be interesting to interview small firms as well to get a better view of how they feel about the relation between patents and Venture Capital.

Informal Network

A surprising finding in this thesis that is not mentioned in the literature is the importance of the Informal Network to the Venture Capitalist. This Network consists of experts in the field the venture capital firm is active in and can call on to give them information. Most Venture Capitalists felt that the informal network was one of the most important elements of their business. An example of the most common types of people in the informal network:

- CEO's and Ex-CEO's of companies they invested in
- Law firms they had done business with
- Experts they had done business with

This network is built by the relations employees had in previous work and the relations built up by the firm by doing business in the field.

What is important to note is that every company (not just a VC-firm) has an informal network, purely through doing business and the relations of employees. However for a VC firm the informal network is of crucial importance. Because Venture Capitalists deal with new

innovations constantly, it is impossible to be informed on all innovation. They do however need to analyze a new innovation on its potential and determine the quality of the technology and the market, before investing in a firm. Because the VC-firm usually invests in a certain or small number of sectors, their relations (i.e. informal network) are all people that are in this sector. Some of these people do have expertise on a certain field within the sector, and they can help the VC-firm analyze the company. This is why the informal network takes a key role in the Venture Capital firm, and why this network is maintained.

This informal network is virtually non-existent in the literature, yet is stated as one of the most important aspects of Venture Capital firms. It seems that it would be worthwhile to research this informal network and find out how this manifests itself and what the influence is of the informal network on the Venture Capital firm.

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Appendix A: Interview Schedule

The Role of Patents in the decision making process of Investors in the Semiconductor Industry

1. What stage (of a Company) do you finance?
   (E.g. Angel, Seed, Early stage, Late stage)

Importance of having a Patent Portfolio

2. How important do you feel Patents are in an IP Protection strategy of a Semiconductor Company?

3. Are Patents necessary for you to invest in a Semiconductor Company?
   - Have you ever invested in a semiconductor company without patents?
   - What was the consideration?

4. If a company does not own a patent, will do you advise a semiconductor to file for a patent?

Benefits and Drawbacks of Patents

5. Do you know a good alternative to Patents for a Start-Up in the Semiconductor industry,
   - Why would this be a good alternative?
   - Why is there no alternative?

6. Do you feel that in the semiconductor industry, the protection of Patents weighs up against the information given away to competitors?

7. Do you see downsides to patents for a start-up semiconductor company?

8. Do you feel there are other benefits to patents besides protection?
   - Such as a better chance to be bought out by a large firm?

Evaluation of Patent Portfolio

9. Do you consider Patents a sign that the start-up is protected legally or as a sign that the company and idea are mature enough to file for a patent? (I.e. sign of protection or quality)?

10. Do you consider patents as a way to analyze information at relatively low costs?

11. How thoroughly do you evaluate patents and related documents?

- Are these documents assessed using a certain set of criteria?
- How is this analysis carried out? (I.e. do you ever hire an expert?)

Infringement

12. Are you worried of the small company's patent being infringed?
- Do you take this into account when investing in the small company?

13. Do you assist the small firm in an infringement lawsuit?
- If so, in what way (financially, advisers, etc.)?

Patent System

14. Do you feel Patents can deter small firms in the semiconductor industry from innovation (because of the need to license from large firms)?

15. Do you feel patents are beneficial to small firms in the semiconductor industry?

Appendix B: Background of Topics

This appendix gives a background information on the 3 areas that are covered in this thesis. These areas are patents, the semiconductor industry and the patent system. This appendix gives general information on these areas, which can be consulted as a reference to the thesis.

1 Patents

Patents and their use have gone through an interesting evolution. The first patent were already in 600 B.C. and since the official introduction of patent law, about a century ago, patents and their use have evolved in ways that the inventors probably couldn't imagine. This chapter gives a description of patents, its history, the ways they are used or not used, what the effects are of this use and possible alternatives to the patent system.

Paragraph 1.1 starts with an explanation of the essence of a patent and who the stakeholders are in the patent 'contract'. In paragraph 1.2 the rationale is given behind the patent system and why this system was introduced.

1.1 Essence of Patents

The World Intellectual Property Organization (WIPO) explains a patent by answering the following three questions:

'What is a patent?

A patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem.

What does a patent do?

A patent provides protection for the invention to the owner of the patent. The protection is granted for a limited period, generally 20 years.

What kind of protection does a patent offer?

Patent protection means that the invention cannot be commercially made, used, distributed or sold without the patent owner's consent. These patent rights are usually enforced in a court, which, in most systems, holds the authority to stop patent infringement. Conversely, a court can also declare a patent invalid upon a successful challenge by a third party.'[7]

Essentially this means that the essence of a patent is a contract between the inventor and society (Grandstrand, 1999). The inventor has to disclose his invention, which has to be new, has

[7] World Intellectual Property Organization;
http://www.wipo.int/freepublications/en/patents/450/wipo_pub_l450pa.pdf

to involve an inventive step, and has to be susceptible of industrial application. As a reward the inventor is granted a monopoly.

An important issue is that a patent is not the right to sell, but it is the right to exclude others from selling. The inventor has no obligation to sell the product himself, he only has the right to exclude others.

1.2 Rationale behind the Patent System

When this 'contract' between the inventor and society was made, the advantages and disadvantages of the system were weighed. The clear disadvantage is the cost to society that the inventor gets a monopoly on the invention (Arrow, 1962), which means that there is no competition, and competition leads to important progress in society (Boldrin & Levine, 2008) .

Society

However there are a number of advantages, which were the rationale for the introduction of the patent system. Mazzoleni and Nelson describe the four rationales for why society has granted the inventor this monopoly (Mazzoleni & Nelson, 1998)[8].

- Patents motivate Invention
- Patent induce the development and commercialization of inventions
- Patents induce disclosure of inventions
- Patents enable orderly development of broad prospects

Patents motivate invention

This is perhaps the best known reason for society to grant patents. The claim is that if companies do not get an appropriate return for their effort they put into the invention, they will stop inventing. It would mean that a company would invest resources into a new invention, only to be imitated shortly after by a competitor who can offer the product for a much lower price, because he did not have to invest in the invention.

If a company will only lose money on the investment in inventions, it will stop inventing, and since society wants new inventions, granting a patent to the inventor will motivate companies to invent.

[8] This paragraph describes an ideal form of the patent system. There is also abundant literature on why the patent system is not helpful and might actually deter innovation.(Arundel, 2001; Arundel & Steinmueller, 1998; Bessen & Maskin, 2006; Boldrin & Levine, 2008; MacDonald, 2003, 2004)

Patent induce the development and commercialization of inventions

A related reason to grant patents is that society not only wants inventions, but wants the inventions to be available. And if companies don't get compensated for the resources invested into the development and commercialization of the invention, it will stop doing it.

An example is when a university has a new invention. If there is no patent on the invention that the company can take over, the company will invests a substantial amount of money in developing and commercializing the invention into a user-product, only to be copied by a competitor who can offer the product for less money, because it did not have to invest in the development and commercialization of the invention. Companies will stop developing and commercializing invention, because they will lose money on it.

Patents induce disclosure of inventions

A separate issue is the disclosure of inventions. One of the reasons society has granted the inventor a monopoly is his obligation to disclose his invention. This gives society an overview of the current technology, and can give other people ideas on how to invent something new, or how to invent the same thing in a different way (inventing around). So again this will spur on innovation.

Patents enable orderly development of broad prospects

The fourth and final rationale is the fact that a broad number of products and/or processes can be developed from a single invention. However it is reasoned that if the invention can be developed by anybody, it will mean that all companies will perceive what the product is with the highest potential and will all develop this product.

However if a one company had the rights over the invention which can potentially be developed into a number of products, the company can take its time with the different developments and society benefits from the larger number of developments from one invention.

2 The Semiconductor Industry

The Semiconductor industry is fairly recent industry, because the semiconductor was only invented about 50 years ago. A semiconductor is a material that has properties of both a conductor and an isolator, dependant the circumstances. This is a very important characteristic, because this allows us to control whether a current will flow through the circuit or not. This control allows us to build all the circuits that are available today.
This chapter covers the specific characteristics of the semiconductor industry.

2.1 Characteristics of the Semiconductor Industry

The semiconductor industry has been through an interesting development. The nature of the industry and its evolution has led it to have specific characteristics. These are different than some other industries and thus have different implications for the policy and legislation. One of these is the patent system. In this paragraph the characteristics of the semiconductor industry are reviewed. The implications of these characteristics on the use of patents in the industry will be discussed in chapter 4.

Complex

On of the characteristics of the innovation in the semiconductors that is inherent to the industry is the fact that it is 'complex'. Cohen (Bessen & Maskin, 2006; Cohen, et al., 2000) speaks of the difference between 'complex' industries and 'simple' industries. A complex industry is one were an innovation is one (or few) product that can be patented, such as in the pharmaceuticals industry. A complex innovation means a collection of many patentable parts. The semiconductor industry is thus a complex industry, because it consists of a multitude of small parts. An new product in the semiconductor industry is rarely the enhancement of one part, but of a large number of subparts.

Sequential

Another characteristic of the semiconductor industry is the fact that the innovation is sequential (Bessen & Maskin, 2006). This can again be compared to the pharmaceutical industry. A substantial part of new drugs that are developed start from scratch, i.e. the drug is developed without using drugs that have already been developed. The number of drugs that are derived from existing drugs is limited. In the semiconductor industry on the other hand this is very different. Because of the complexity and use of multiple subparts, the innovations build on each other and thus old innovations are used to make new ones. This means that the semiconductor industry is sequential.

Reverse Engineering

An important fear in technology is reverse engineering. This means taking an existing product and trying to take it apart to see how it is build. For a product such as for instance an analog watch this can be a fairly easy process. You take apart the watch; see which parts are inside the watch and how they interact, and then try to rebuild it.

However for semiconductor products this is a whole different ballgame. First of all the size of semiconductor products makes it very difficult and with the increasing minimization of chips this process is becoming more and more difficult. This is not to say that it is not possible, but it does mean that it is a costly and time-consuming process for semiconductor products.

Speed of Development

The speed of development in the Semiconductor industry is very high. Illustrative of the speed of development in the semiconductor industry is that Gordon Moore, one of the co-founders of Intel, predicted that the number of transistors on a chip would double every year. It turned out that this was closer to every 20 months, but this is still an incredible speed.

Combination

The characteristics of this industry have lead to specific behaviour in this industry. The first is that the companies find lead time an important way to appropriate returns on their innovation. This is a combination of the speed of development and the difficulty of reverse engineering.

Another important issue is the sliding down the learning curve. This is also related to the speed of development. Because of the high speed and complexity of the products, companies learn how to be efficient in the production of new products. So even if a competitor could reverse the product, the first company would have an advantage because of the learning curve they have already experienced.

Venture Capital is the high risk investment in start-up companies/technologies. Venture capitalists raise money from institutional investors, and invest those in (mostly high-tech) companies that, because of high risk, cannot apply for loans from financial institutions such as banks. Venture Capitalists are intermediaries between institutional investors and firms. The institutional investors (such as pension funds), invest their money in a Venture Capital firm, which in turn invests it in Start-Up firms.
In this chapter the history and nature of venture capital is discussed, followed by the effects of venture capital and the selection criteria of venture capitalists. This is followed by a brief paragraph on the relationship between patents and venture capital.

3.1 History and Nature of Venture Capital

This paragraph consists of the nature of venture capital, which is broken up into several parts. First of all a short history of the venture capital is given, which shows the growth of the industry. This is followed by an overview of the different flows (of money, equity, etc.) and the role of the venture capitalist. This is followed by an explanation of the relationship between Venture Capitalist and the Entrepreneur. Then an overview is given of the different roles a venture capitalist plays. A small overview of the history of venture capital concludes this paragraph.

History of Venture Capital

Although the concept of financing entrepreneurs that lack funds (back to the Babylonian partnerships (Lutz, 1932)) is very old, the modern Venture Capital industry started after the second world war. The first real Venture Capital company was American Research and Development (ARD), which was founded in 1946. The idea behind this company was to commercialize technologies that had been developed during the war (Gompers & Lerner, 2004). The amount of money invested in venture capital increased greatly in the late 1970s early 1980s. In the beginning mostly private investors invested in venture capital, but there has been a shift to institutional investors. The rise can be seen in Figure 6.

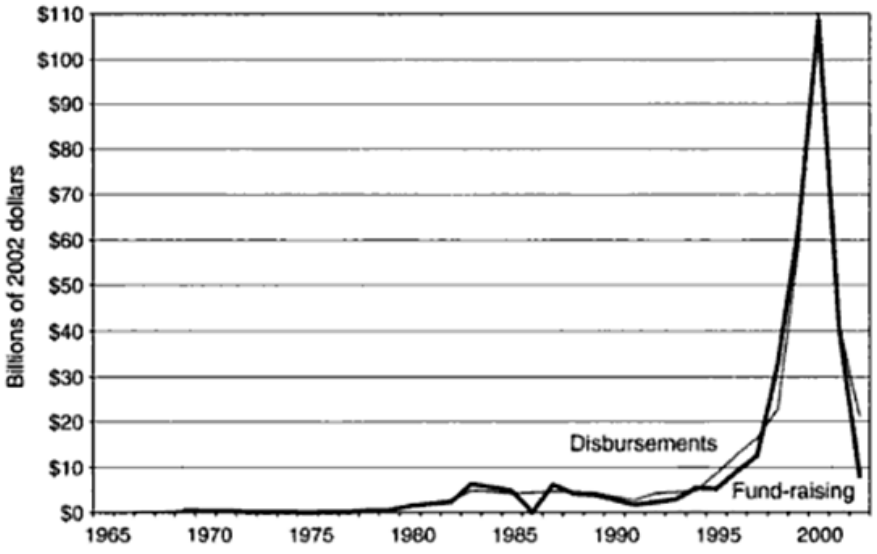

FIGURE 6: DOLLAR VOLUME OF VENTURE CAPITAL DISBURSEMENTS AND FUND-RAISING, BASED ON TABULATIONS OF UNPUBLISHED VENTURE ECONOMICS DATABASES. (DATA ON VENTURE CAPITAL FUND-RAISING NOT AVAILABLE BEFORE 1969) (GOMPERS & LERNER, 2004)

Overview of flows

The Venture capital is in essence the intermediary between (institutional) investors and entrepreneurs. The venture capital is entrusted with the money of the investor, and is expected to give above average results after a period of time. The venture capitalist in turn invests this money in entrepreneurs and is given equity in return (preferred-) equity in the entrepreneurship. If the entrepreneurship does well and goes public (IPO), the Venture capitalist can sell his equity. An overview of this is given in Figure 7, which is structured as a limited partnership, in which the investors are the limited partners, and the venture capitalists are general partners (Gompers & Lerner, 2004).

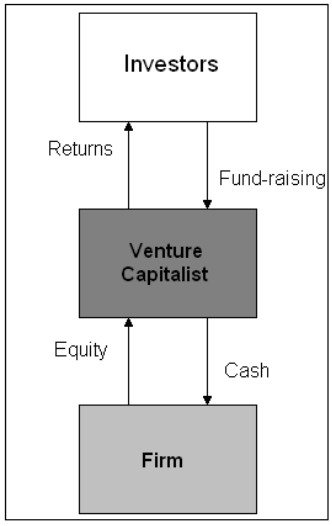

FIGURE 7: OVERVIEW OF THE VENTURE CAPITAL PROCESS (GOMPERS & LERNER, 2004)

Investment in Entrepreneurs

Venture Capital is a phenomenon that has existed for a long time. Entrepreneurs have always had ideas that required capital, and needed funding to carry out these ideas(Gompers & Lerner, 2004). A common way to finance a project is to get a bank loan. However with a bank loan hard assets are required to secure the debt (Zider, 1998). This is where Venture Capitalists step in; they finance a company without collateral, which means a higher risk. For this high risk, a Venture Capitalist requires high returns. This high return is usually (preferred-)equity ownership. The investment in Entrepreneurships happens in stages. The staging of investments in the entrepreneurship is critical for the Venture Capitalist to take away some of the information asymmetries. Through staging of the investment, an entrepreneur is forced to give results to the Venture Capitalist in order to get the next investment. This gives the venture capitalist a better overview of the value of the entrepreneurship and whether a next investment is justified (Gompers, 1995).

Roles of Venture Capitalist

Although the initial task of a Venture Capitalist is as intermediary between investors and entrepreneurs, the role of the Venture Capitalists has expanded greatly. There are a number of roles a Venture Capitalist has to fulfill, both before investment, all the way to the IPO of a company (Gompers & Lerner, 2004).

The first role of the Venture Capitalist is considered to be the relationship with the investors, such as pension funds and insurance funds, which provide the Venture Capitalist with funds. The raising of capital doesn't happen continuously, but in periodic funds (Gompers & Lerner, 2004). Usually these funds are in the form of a limited partnership and have a life of about 10 years. These funds are than disbanded and a new fund is raised. A Venture Capitalist can have multiple funds at the same time, but each fund is a separate limited partnership.

The second role of the venture capitalist is the selection of profitable companies. A venture capitalist examines a large number of ideas and only invests in a small number of them, which is approximately 6 out of every 1000 plans(Mann, 2005). Paragraph 0 will discuss the selection criteria of VC's.

The third role of the Venture Capitalist is the monitoring and assisting of the entrepreneurship. A Venture Capitalist has to assure that the entrepreneurship is on the right track. This is done through monitoring the company (staging of investment is an example of this). However an important task of the Venture Capitalist is to assist the entrepreneurship. The Venture Capitalist usually has expertise and a network people that can assist in the entrepreneurship. This can be through advice, strategic plans, hiring and or replacing certain people, etc.

The final role is managing the exit of the investments. The most profitable for a Venture Capitalist is to take the entrepreneurship public (IPO). Although only 20-35% of Venture backed firms go public, it is the main source of income for the venture capitalist. Other forms of exiting investments are liquidating the firm, or sell to corporate acquirers (Gompers & Lerner, 2004).

3.2 Effects of Venture Capital

Although Venture Capitalists are essentially only intermediaries between investors and entrepreneurs, research has shown that they have a significant influence on the performance of companies. In this paragraph the influence of venture capitalists will be discussed in the areas of company growth (in terms of personnel), influence on professionalization of the start-up firm, influence on innovation and finally the influence of venture capitalists on the performance of start-ups.

Growth (Number of Employees)

The number of employees is a measure to evaluate the growth of a firm. Research conducted by Davila et al. shows that there is a significant difference in personnel growth when comparing Venture-backed firms to Non-Venture-backed firms. As can be seen in ,over the course of time, Venture-backed firms have about double the number of employees compared to Non-Venture backed firms (Davila, Foster, & Gupta, 2003).

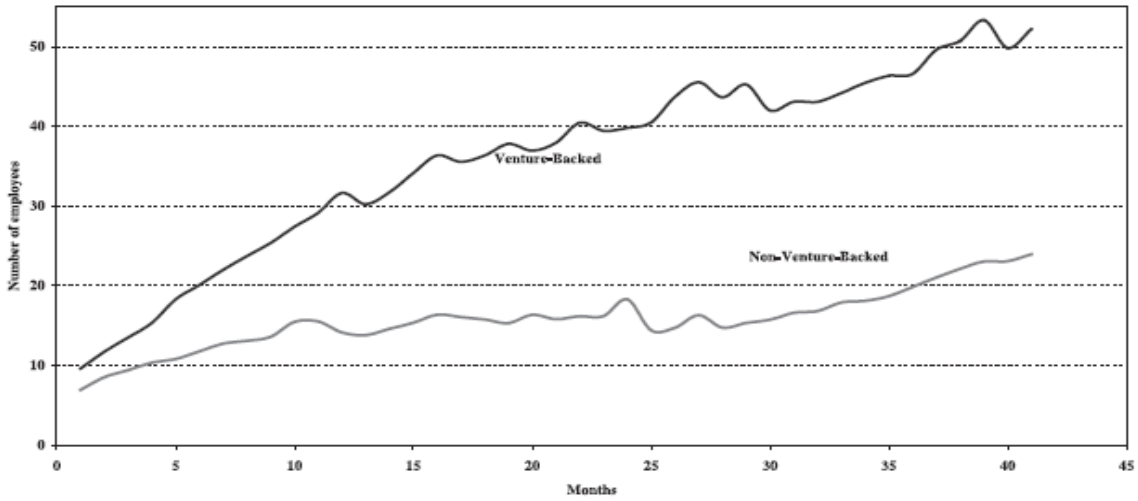

FIGURE 8: GROWTH FOR VENTURE-BACKED AND NON-VENTURE-BACKED FIRMS (MEAN NUMBER OF EMPLOYEES) (DAVILA, ET AL., 2003)

Professionalization (Human Resource)

Research conducted by Hellman & Puri (2002) shows the influence of Venture Capital in the professionalization of start-up firms. This research concentrates on 4 areas, namely replacement of original founders with an outside CEO, introduction of option plans, hiring of a VP of sales and marketing and the formulation of human resource policies.

'Obtaining venture capital is related to a variety of organizational milestones, such as the formulation of human resource policies, the adoption of stock option plans, or the hiring of a VP of sales and marketing. Firms with venture capital are also more likely and faster to replace the founder with an outsider in the position of the CEO […]. The effect of venture capital is also particularly pronounced in the early stages of a company's development' (Hellman & Puri, 2002).

This research suggests that Venture Capitalists have a significant influence on internal affairs of a start-up, which shows that the role of the venture capitalists extends beyond simple fund provider.

Innovation

An important question is the influence of Venture Capital on innovation. If Venture Capital spurs innovation, it is a useful part of today's marketplace. However if Venture Capital were to deter innovation, governments could be questioning the usefulness of Venture Capital. Kortum and Lerner (2000) have researched this and found that Venture Capital indeed spurs innovation.

'The results are robust to different measures of venture activity, subsamples of industries, and representations of the relationship between patenting, R&D, and venture capital. […]. This estimate suggests that venture capital accounted for 8% of industrial innovations in the decade ending in 1992. Given the rapid increase in venture funding since 1992, and assuming that the potency of venture funding has remained constant, the results imply that by 1998, venture funding accounted for about 14% of U.S. innovative activity.'

Performance

Finally, the difference in performance between Venture-backed and Non-Venture backed firms is researched by Jain & Kini (1995).

'We find that VC-backed IPOs exhibit relatively superior post-issue operating performance compared to a control sample of non-VC-backed IPOs matched as closely as possible to industry and offering size. Further, cross-sectional regression analyses reveal that the VC-backed firms continue to demonstrate relatively superior operating performance after controlling for other determinants of post-issue operating performance. We find evidence to suggest that the capital markets recognize the value-added potential of VC monitoring. The VC-backed issuers initially have significantly higher levels of market-to-book ratio and price/earnings ratio compared to the non-VC-backed issuers. Subsequently, the difference between the two groups of IPO issuers disappears. One explanation for this result is that the monitoring services of VCs are most valuable during the early stages of the issuers transition to a public corporation. Subsequently, as the VCs exit and market monitoring takes over, the incremental value-added potential of VC monitoring declines.' (Jain & Kini, 1995).

Appendix C: History of Patenting in the Semiconductor Industry

TABLE 5: SEMICONDUCTOR PATENTS AWARDED TO FIRMS IN THE UNITED STATES, 1952-1968 (TILTON, 1971)

Type and name of firm	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*	*1952–68*
Bell Laboratories[a]	**34**	**47**	**36**	**27**	**48**	**34**	**51**	**72**	**67**	**67**	**55**	**54**	**41**	**64**	**59**	**41**	**38**	**835**
Receiving tube firms																		
RCA	14	19	16	10	44	45	57	46	34	33	33	27	41	58	75	63	53	668
General Electric	5	7	6	11	25	13	35	34	26	36	42	35	38	86	76	64	41	580
Westinghouse	2	6	2	4	9	7	21	25	30	21	23	18	23	78	54	46	41	410
Sylvania	1	4	6	1	11	14	19	9	13	7	13	10	9	14	7	12	8	158
Philco-Ford	0	0	0	1	3	4	7	13	14	13	14	9	8	12	17	9	6	130
Raytheon	0	1	0	1	7	3	10	8	6	6	4	7	3	5	6	4	1	72
Tung-Sol	0	0	0	1	0	0	3	1	0	2	5	1	2	5	2	4	0	26
Columbia Broadcasting System	0	0	0	2	2	0	1	1	0	0	1	0	0	1	1	0	0	9
Subtotal	**22**	**37**	**30**	**31**	**101**	**86**	**153**	**137**	**123**	**118**	**135**	**107**	**124**	**259**	**238**	**202**	**150**	**2,053**
New firms																		
International Business Machines	1	1	0	1	4	6	15	22	25	37	96	53	47	56	70	46	41	521
Texas Instruments	0	0	0	0	0	2	9	8	22	13	20	24	16	43	35	52	42	286
Motorola	0	1	3	2	5	11	8	8	9	10	10	6	8	26	25	39	19	190
Hughes	0	0	5	3	9	12	18	11	3	9	10	7	9	19	16	16	13	160
Honeywell	0	0	0	0	1	2	5	17	13	12	38	16	15	11	18	9	3	160
Sperry Rand	0	0	0	1	0	5	5	7	7	6	13	9	11	35	18	15	7	139
General Motors	0	0	0	0	0	0	6	5	8	12	3	5	8	26	31	16	13	133
International Telephone and Telegraph[b]	2	2	0	4	4	2	11	15	10	6	18	4	6	7	5	9	6	111
Clevite	0	0	3	3	2	1	3	3	7	7	4	12	17	10	3	2	1	78
Bendix	0	1	1	0	0	3	2	4	7	9	0	5	3	15	16	6	5	77
Thompson Ramo Wooldridge	0	0	0	0	0	1	3	7	3	18	11	11	2	4	0	0	0	60
Fairchild	0	0	0	0	0	0	0	0	1	4	2	3	6	10	10	11	5	52
Sprague	0	0	0	0	2	2	2	8	2	1	4	3	5	6	6	5	6	52
17 other new firms	1	3	1	1	10	7	16	22	15	12	21	9	7	30	33	10	23	221
Subtotal[c]	**4**	**8**	**13**	**15**	**37**	**54**	**103**	**137**	**132**	**156**	**250**	**167**	**160**	**298**	**286**	**236**	**184**	**2,240**
Total[c]	**60**	**92**	**79**	**73**	**186**	**174**	**307**	**346**	**322**	**341**	**440**	**328**	**325**	**621**	**583**	**479**	**372**	**5,128**
Percentage of total																		
Bell Laboratories	*56*	*51*	*46*	*37*	*26*	*20*	*17*	*20*	*21*	*20*	*12*	*16*	*13*	*10*	*10*	*9*	*10*	*16*
Receiving tube firms	*37*	*40*	*38*	*42*	*54*	*49*	*50*	*40*	*38*	*34*	*31*	*33*	*38*	*42*	*41*	*42*	*40*	*40*
New firms	*7*	*9*	*16*	*21*	*20*	*31*	*33*	*40*	*41*	*46*	*57*	*51*	*49*	*48*	*49*	*49*	*50*	*44*

TABLE 6: FRENCH SEMICONDUTOR PATENTS AWARDED TO FIRMS IN GERMANY, 1954-1968 (TILTON, 1971)

Type and name of firm[a]	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*	*Total 1954 -68*
Receiving tube firms																
Siemens	16	9	10	4	17	36	53	41	45	52	58	69	103	41	47	601
Standard Elektrik Lorenz	7	12	4	8	1	15	2	5	7	9	11	6	13	13	24	137
Allgemeine Elektrizitäts Gesellschaft-Telefunken	0	0	0	0	0	0	2	6	7	2	2	8	17	10	10	64
Valvo	7	10	15	8	22	38	41	41	40	43	26	34	42	23	68	458
Subtotal	**30**	**31**	**29**	**20**	**40**	**89**	**98**	**93**	**99**	**106**	**97**	**117**	**175**	**87**	**149**	**1,260**
New firms																
Intermetall	0	0	0	0	0	0	3	5	3	4	3	4	0	0	0	22
Semikron	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**5**	**4**	**4**	**3**	**4**	**1**	**0**	**0**	**24**
New foreign subsidiaries																
Società Generale Semiconduttori-Deutschland	0	0	0	0	0	0	0	6	2	0	4	1	2	1	2	18
Texas Instruments-Deutschland	0	0	0	0	7	0	8	7	15	11	3	10	22	18	21	122
Subtotal	**0**	**0**	**0**	**0**	**7**	**0**	**8**	**13**	**17**	**11**	**7**	**11**	**24**	**19**	**23**	**140**
Total	**30**	**31**	**29**	**20**	**47**	**89**	**109**	**111**	**120**	**121**	**107**	**132**	**200**	**106**	**172**	**1,424**
Percentage of total																
Receiving tube firms	*100*	*100*	*100*	*100*	*85*	*100*	*90*	*84*	*83*	*88*	*91*	*89*	*87*	*82*	*87*	*88*
New firms	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*4*	*3*	*3*	*3*	*3*	*1*	*0*	*0*	*2*
New foreign subsidiaries	*0*	*0*	*0*	*0*	*15*	*0*	*7*	*12*	*14*	*9*	*6*	*8*	*12*	*18*	*13*	*10*

TABLE 7: FRENCH SEMICONDUTOR PATENTS AWARDED TO FIRMS IN FRANCE BRITAIN, 1954-1968 (TILTON, 1971)

Type and name of firm[a]	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*	*Total 1954 –68*
Receiving tube firms																
Compagnie Française Thomson-Houston	24	20	14	15	18	19	12	14	21	10	7	5	9	2	16	206
Compagnie Générale d'Electricité	0	0	0	0	0	0	0	1	2	1	4	3	4	3	7	25
Compagnie Générale de Télégraphie Sans Fil	2	3	1	2	6	4	1	2	5	9	3	3	2	5	0	48
Radiotechnique Compelec	7	10	15	8	22	38	41	41	40	43	26	34	42	23	68	458
Subtotal	**33**	**33**	**30**	**25**	**46**	**61**	**54**	**58**	**68**	**63**	**40**	**45**	**57**	**33**	**91**	**737**
New firms																
Compagnie des Dispostifs Semiconducteurs Westinghouse	1	0	2	1	1	1	1	1	0	2	0	1	0	0	0	11
Le Matériel Téléphonique[b]	7	12	4	8	1	15	2	5	7	9	11	6	13	13	24	137
Société Industrielle de Liaisons Electriques	0	0	0	0	0	3	0	1	0	1	0	1	1	0	3	10
Soral	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2
Subtotal	**8**	**12**	**6**	**9**	**2**	**19**	**4**	**7**	**8**	**12**	**11**	**8**	**14**	**13**	**27**	**160**
New foreign subsidiaries																
International Business Machines–France	0	1	4	2	18	4	5	9	12	13	27	29	38	27	37	226
Motorola	0	0	0	0	0	0	0	0	1	5	8	4	13	7	13	51
Società Generale Semiconduttori–France	0	0	0	0	0	0	0	6	2	0	4	1	2	1	2	18
Sprague-France	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	6
Texas Instruments–France	0	0	0	0	7	0	8	7	15	11	3	10	22	18	21	122
Subtotal	**0**	**1**	**4**	**2**	**25**	**4**	**13**	**22**	**30**	**29**	**42**	**44**	**78**	**53**	**76**	**423**
Total	**41**	**46**	**40**	**36**	**73**	**84**	**71**	**87**	**106**	**104**	**93**	**97**	**149**	**99**	**194**	**1,320**
Percentage of total																
Receiving tube firms	*80*	*72*	*75*	*69*	*63*	*72*	*76*	*67*	*64*	*61*	*43*	*47*	*38*	*33*	*47*	*56*
New firms	*20*	*26*	*15*	*25*	*3*	*23*	*6*	*8*	*8*	*11*	*12*	*8*	*9*	*13*	*14*	*12*
New foreign subsidiaries	*0*	*2*	*10*	*6*	*34*	*5*	*18*	*25*	*28*	*28*	*45*	*45*	*53*	*54*	*39*	*32*

TABLE 8: FRENCH SEMICONDUTOR PATENTS AWARDED TO FIRMS IN GREAT BRITAIN, 1954-1968 (TILTON, 1971)

Type and name of firm[a]	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*	*Total 1954 –68*
Receiving tube firms																
Associated Electrical Industries	0	1	0	1	6	17	17	10	12	17	8	7	6	3	9	114
Standard Telephones and Cables	7	12	4	8	1	15	2	5	7	9	11	6	13	13	24	137
Mullard	7	10	15	8	22	38	41	41	40	43	26	34	42	23	68	458
Subtotal	**14**	**23**	**19**	**17**	**29**	**70**	**60**	**56**	**59**	**69**	**45**	**47**	**61**	**39**	**101**	**709**
New firms																
General Electric Company Ltd.	2	0	6	3	9	7	3	2	7	4	1	0	0	0	0	44
Joseph Lucas	0	0	0	0	0	0	0	0	1	1	0	2	3	3	1	11
Marconi Elliott Micro-electronics	0	1	0	1	1	2	2	0	1	0	0	1	0	0	0	9
Newmarket	0	0	1	1	0	2	0	0	1	0	0	0	0	0	0	5
Plessey	0	0	0	0	0	6	0	0	0	0	1	3	0	0	1	11
Westinghouse Brake and Signal	0	0	3	11	5	3	0	4	10	7	5	1	7	2	2	60
Associated Transistors	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Subtotal	**2**	**1**	**10**	**16**	**15**	**20**	**5**	**6**	**22**	**12**	**7**	**7**	**10**	**5**	**4**	**142**
New foreign subsidiaries																
Texas Instruments Ltd.	0	0	0	0	7	0	8	7	15	11	3	10	22	18	21	122
Brush Clevite	0	0	0	0	0	0	4	2	4	5	3	1	0	0	0	19
International Rectifier	0	0	0	0	0	0	1	0	0	1	2	2	1	2	9	18
Emihus Microcomponents	0	0	0	0	2	7	1	2	4	3	0	3	4	1	1	28
Società Generale Semicon-duttori-U.K.	0	0	0	0	0	0	0	6	2	0	4	1	2	1	2	18
Subtotal	**0**	**0**	**0**	**0**	**9**	**7**	**14**	**17**	**25**	**20**	**12**	**17**	**29**	**22**	**33**	**205**
Total	**16**	**24**	**29**	**33**	**53**	**97**	**79**	**79**	**106**	**101**	**64**	**71**	**100**	**66**	**138**	**1,056**
Percentage of total																
Receiving tube firms	*87*	*96*	*66*	*52*	*55*	*72*	*76*	*71*	*56*	*68*	*70*	*66*	*61*	*59*	*73*	*67*
New firms	*13*	*4*	*34*	*48*	*28*	*21*	*6*	*8*	*21*	*12*	*11*	*10*	*10*	*8*	*3*	*14*
New subsidiaries	*0*	*0*	*0*	*0*	*17*	*7*	*18*	*21*	*23*	*20*	*19*	*24*	*29*	*33*	*24*	*19*