

Friday, June 27, 2014

The Appropriability regime as a tool to measure knowledge protection

Author: Thomas Smit
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands
t.g.j.smit@student.utwente.nl

The appropriability regime consists of a combination of means to protect knowledge and the return of investments made on innovation. The protective strategy chosen by the company is of great importance because scarce resources are spent, and R&D derived knowledge should not flow away towards competitors. The regime consists of a combination of appropriability mechanisms; the nature of knowledge, institutional protection, HRM, practical/technical means, and lead-time. The chosen strategy is dependent on availability, strength, efficacy and goal. In this paper we use this appropriability regime to scrutinize the appropriability strategy of GPS producer Garmin, and try to explain its relation with the market competitors. We use secondary data as source to examine the different mechanisms. With this we want to study whether the appropriability regime is a usable scheme to research companies and markets, to explain past happenings, and to foresee and predict future cases.

Supervisors: Patrick Blik and Sandor Löwik

Keywords

Appropriability regime, strategy, innovation, absorptive capacity, institutional protection, R&D

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

3rd International Business Administration Bachelor Thesis Conference, July 3rd, 2014, Enschede, The Netherlands.
Copyright 2014, University of Twente, Faculty of Management and Governance.

1. INTRODUCTION

It is important for innovating companies to protect its knowledge and prevent losing idea's towards competitors. This way the company is able to receive the potential returns on investment in innovation, which can be quite significant resources for a company. "Appropriability conditions refer to the degree to which firms capture the profits associated with their innovative activity and are often considered to reflect the degree to which valuable knowledge spills out into the public domain" (Cohen & Levinthal, 1990). A system of different mechanisms to protect innovation is called the appropriability regime (Hurmelinna-Laukkanen & Puumalainen, 2007). The appropriability regime is made up out of different mechanisms that separately have been previously researched quite intensively. E.g. intellectual property right (Barney, 1991; Dierickx & Cool, 1989; Lippman & Rumelt, 1982; Polanyi, 1966; Teece, 1998) and the nature of core knowledge (Leonard-Barton, 1992; Teece, 1998).

In this paper we are going to use as a case the global positioning system (GPS) company Garmin, which is active in the personal navigation device (PND), aviation, marine, and outdoor & fitness segment. Garmin has been active since 1989 in GPS technology, developing and building equipment for the US military. In the year 2000 the US government discontinued the so called "Selective Ability" which degraded the accuracy of GPS to a radius of 100 meters (Garmin, 2005; McGinn, 2007). This change made it possible for non-army use of the GPS signals, to be as accurate as we know it nowadays, which is needed to be able to use the technology for personal navigation. Garmin was the first to enter the PND market with the Garmin Streetpilot. Other competitors entered the market in 2001. One of the competitors was the Dutch TomTom, formerly software producer for handheld devices. Garmin and TomTom both have been market leaders in the PND segment for some years with Garmin being the strongest party in the US, and TomTom being the first choice in Europe (GPSmagazine, 2008). Another big player is MiTAC International Corporation, which consists of Magellan Navigation Inc, Mio technology ltd and Navigon (Garmin, 2007).

In this article we will be looking mainly at the PND segment of Garmin, because we can compare this with the competitors, which are not all active in the other market segments named above.

During the release of the Streetpilot one might state that Garmin had the key knowledge on GPS in-house, having more than 10 years experience with this technology. Thus Garmin should have been able to exploit this knowledge and skills, resulting in a big share in the market. However as we mentioned above this was not the case, both Garmin and TomTom had likewise sales (Bizjournals, 2007). For example in the second quarter of 2007 Garmin shipped 1.85 million units (24.9%) and TomTom 1.81 million (24.3%). In this paper we are going to try to explain why Garmin might have lost part of the market share to TomTom or other competitors using the appropriability regime theory mentioned earlier. This regime gives us a total view of protection, because it looks at a diversity of mechanisms. The appropriability regime has been tested on 299 finish companies by Hurmelinna-Laukkanen and Puumalainen (2007), but has not been used to try to explain certain past happenings in a market. With this article we want to add a case study to the existing literature, in which we show that we can use the appropriability regime to explain which strategy of protection a company used, and what effect this had. Also this might result in management advice for future strategy.

In this article we are first going to look at the current theories on this topic. Further on the methods of research and data collection will be explained. After that the data findings and results will be presented, and we will end with the conclusions, limitations and recommendations.

2. THEORY

2.1 Appropriability regime

Hurmelinna-Laukkanen and Puumalainen (2007) conducted a appropriability regime made out of different mechanisms that are used by firms to protect innovations and the possible corresponding returns. These are a combination of technological and marketing capabilities, existing knowledge base and for example the ability to learn. Also there are certain ways to prevent competitors from imitating products which are previously researched individually. Examples of this are intellectual property rights, contracts and lead time. In total this regime should be able to protect innovations from imitators. We will discuss all mechanisms briefly below.

2.1.1 Nature of knowledge

The nature of knowledge is important for a company. Knowledge can be explicit or tacit. Explicit knowledge of technology needs to be protected because it is quite easy to copy. If this information is of key value to the company it should be protected with high care by e.g. codifying (Hurmelinna-Laukkanen & Puumalainen, 2007). Tacit knowledge is harder to copy because this knowledge is embedded in routines and capabilities (Teece, 1995). This knowledge cannot be documented because it needs interaction, shared understanding and trust. Where explicit knowledge can be gained by e.g. reverse engineering, tacit knowledge can only be acquired through practical experience in a relevant context (Polanyi, 2012). This makes it more difficult to copy because knowledge and skills of employees and their routines are needed to exploit. Tacit knowledge can work as an effective mean to protect from imitation because competitors might not be able to produce an imitating product without this tacitness.

2.1.2 Institutional protection

One of the mechanisms most extensively researched is institutional protection in particularly intellectual property rights. This e.g. concludes patents, copyrights, trademarks, trade and secrets. Also combinations of the different IPR's can be used to create the best protection possible. IPR's are a formal means of protecting innovation, however also require disclosure, and thus providing the market with signals that the firm has some new technology or product (Hurmelinna-Laukkanen & Puumalainen, 2007).

Another way of institutional protection is contracts. A non-discloser contract with an (key) employee for example can prevent key knowledge to flow away to competitors because the employee won't be able to work at the competition (Hurmelinna-Laukkanen & Puumalainen, 2007).

2.1.3 Human Resource Management (HRM)

As been told key employees can be of critique value for a company so it is important to keep those employees inside. The firms function responsible for recruiting, directing and dismissing personnel is Human Resource Management. The HRM-responsible should manage information flows, communication and also is in charge of making contracts with employees. With good labor contracts employees can be made partially immobile, and thus can't work at other competitors (non-competition). But also HRM can make (key) employees want to stay because of good work circumstances, good pay,

option arrangements etc (Hurmelinna-Laukkanen & Puumalainen, 2007).

2.1.4 Practical / technical means

Companies also use practical means to protect data and information. This can be passwords on databases, ways to prevent copying and various other possible technical protections. Secrecy, which overlaps with IPR's and HRM, is also a general way to prevent information leaking towards the market. Some key information (e.g. a secret recipe) is only known to certain personnel, and thus making it less likely that innovations flow towards the market (Hurmelinna-Laukkanen & Puumalainen, 2007).

2.1.5 Lead time

The last mechanism of the appropriability regime is lead time. This is not a pure protective mechanism as the previously explained, but a more pro-active one. Being first to market and continuously keep improving is important. By being faster with new innovations than the competitors can imitate, less returns are lost (Levin, Klevorick, Nelson, & Winter, 1987).

All mechanisms are summarized and combined in (Hurmelinna-Laukkanen & Puumalainen, 2007) Appropriability Regime as shown in figure 1.

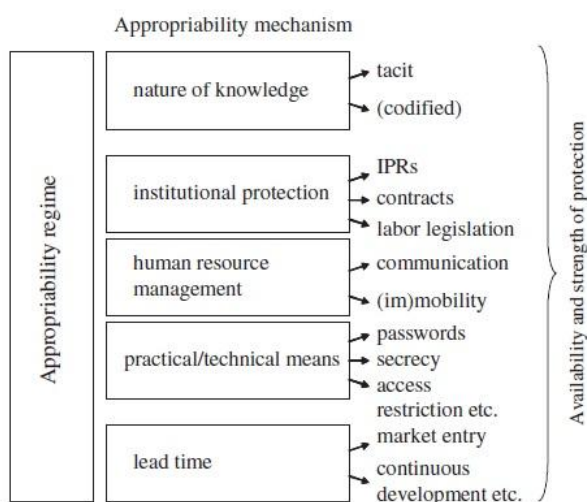


Figure 1: The appropriability regime and its building blocks.

2.2 Appropriability Strategy

The regime described above combines the different mechanisms. Which specific mechanisms are used is a strategic choice of the company and differs in different types of markets. Availability differs in markets, and also the efficacy (strength) of the mechanisms may vary across markets. Further combinations of different mechanisms are possible e.g. secrecy tries to make information available only for those employees that need to know, and the HRM function will use contracts and labor legislation to be able to prevent employees from sharing this crucial information. There can be made a distinction between mechanisms and their intention. There are prerequisite, derivative and supportive appropriability mechanisms (Hurmelinna-Laukkanen & Puumalainen, 2007).

Prerequisite mechanisms are a set of mechanism that are needed in order to make other mechanisms possible like the example mentioned above. Derivative mechanisms are not necessarily needed to protect innovation but buy some time, in order to make the mechanism lead time possible. For example patents can protect a certain idea for a while, in that time the company's

R&D department can come up with new technology or products, and create a competitive advantage. Supportive mechanisms support certain other mechanisms. E.g. a contract can help remembering personal that there are trade secrets, and that they cannot disclose information (Hurmelinna-Laukkanen & Puumalainen, 2007). It is important that managers of a company are aware of the appropriability strategy and its components, in order to protect its innovations.

The chosen appropriability strategy will result in certain strength of protection against imitation, but there are also other strategic goals possible. For example IPR's can be used to create value by licensing. Likewise there can be a difference between short and long term goals (Hurmelinna-Laukkanen & Puumalainen, 2007).

The company has to take into account that the chosen strategy is efficient because protection is at a cost (Hurmelinna-Laukkanen & Puumalainen, 2007). For example patenting is expensive, and also may lead to expensive court cases. Also a very high salary will probably keep (key) employees in the company, but will decrease profits rapidly.

Furthermore there can be made a distinction between incremental and radical innovations and the need for appropriability. Incremental innovations, building on existing products and technologies, need a stronger protection than radical innovations, new products and techniques. This is because incremental innovations are easier to achieve by imitators, and take less time to implement. For radical innovation less protection is needed, and it might be even profitable to share technology and gain profits with that strategy (Hurmelinna-Laukkanen, Sainio, & Jauhiainen, 2008).

2.3 Competitive advantage

A firm has a competitive advantage when it is implementing a value creating strategy which is not currently being implemented by other (potential) competitors. When other firms are unable to duplicate the benefits of this strategy we can speak of sustained competitive advantage (Barney, 1991). This subject is of interest in this paper because a competitive advantage can be dissolved by a poor appropriability, leaking away key knowledge to the competitor.

2.4 Absorptive capacity

(Cohen & Levinthal, 1990) have researched absorptive capacity. This is the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" and is critical to its innovative capabilities. This topic is of value for this article because absorptive capacity makes use of information in the market which is possibly lacked by a poor appropriability regime. (Hurmelinna-Laukkanen, et al., 2008) state that the extent to which an imitator can obtain knowledge out of the market depends on two factors; the innovators' appropriability regime, and the imitators' absorptive capacity. In this article this will not be the topic of research, but we will look at the information spilled. However this topic is of importance because absorptive capacity of other companies is one of the reasons a good appropriability regime is needed.

2.5 Research model

The model we will be using in this article is based on the appropriability regime show in figure 1. In figure 2 the integrated model is shown.

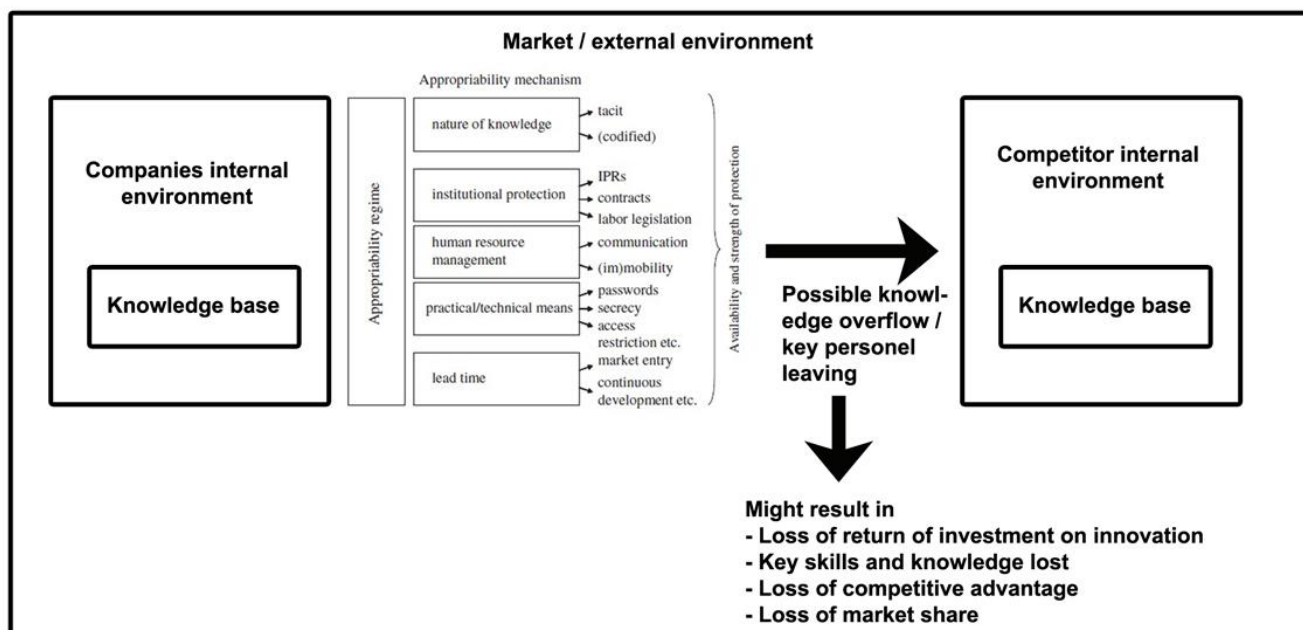


Figure 2: the appropriability model for Garmin

For this study we use Garmin as a case. As can be seen in figure 2 we take the knowledge base of a company (Garmin in this case) as the base of our research. We apply the appropriability regime theory on Garmin and try to look at what mechanisms Garmin makes use of and what the strength is. Also the competitors are shown in the external environment. The theory states that when appropriability regime is poor, and so the barrier around the internal environment is weak, knowledge can flow towards the market. This can be tacit/codified knowledge overflow, but also key personnel leaving to the competitor. Personnel leaving results in a gap in the routines of the company itself, and can bring advantage for the competition because knowledge and ideas are brought towards the company (thus resulting in knowledge overflow). If the absorptive capacity of the competitors is well developed, the ideas will be recognized, assimilated, and applied to commercial ends. This way returns on investment on R&D of Garmin will decrease, possibly market share will be lost. Also if some mechanisms are poor it is possible that key employees, skills and knowledge are lost to the competitors. This all can result in a loss of competitive advantage for Garmin.

3. METHODOLOGY

In order to answer the research question we will need to measure the individual appropriability mechanisms. We will do this by using secondary data, mainly the annual reports by Garmin. Those reports for example contain quite clear information about patents and trademarks and how they are used. Garmin is a listed company so they have to disclose detailed information on certain subjects, however on some other mechanisms this reports will disclose less information (e.g. secrecy). This is one of the limitations of this study. We use reports from 2001 till 2013. With the results of this part of the study we can conclude how strong the appropriability regime of Garmin was during the years and might show some weaknesses.

(Hurmelinna-Laukkanen & Puumalainen, 2007) researched 299 finish companies in order to determine the roles, availability, efficiency and strength of the appropriability mechanisms. The companies were from several industrial sectors that were engaged in R&D, to keep the results generally usable. Although the results might not fit the PND market exactly, we will for now considerer them usable. They concluded that IPR, labor

legislation, and HRM were considered weak mechanisms (Likert scales → 2.30, 2.01, 1.37), and lead-time and technical means were conceived strong (3.29, 3.27). The use (% of products mechanisms are used on) of appropriability mechanisms was for IPR's 23.10%, technical means were used 40.80%, and 19.2% HRM was used. Further long term value and creating a barrier were considered more important than short term value.

To measure the loss of knowledge and competitive advantage we need to look at how competitors could have made use of knowledge of Garmin. Of course if it would have been clear that one of the competitors stole information by working around secrecy or burglary of files there would be evidence of court cases. Also if patent rights would have been infringed enforcement would have been possible for Garmin and court cases would have been won, which we could find the evidence from. Also there might be court cases claiming patent suits which aren't actually won. But those also give evidence how Garmin thinks about its own appropriability.

Finally we will have a look at TomTom's absorptive capacity, because this is one of the reasons why appropriability is important. Theory states that the stronger the absorptive capacity is, the more important appropriability is. We will use the study of another student to provide us with some information about this subject.

We combine these results in order to answer the research question, and see if Garmin potentially lost competitive advantage by its poor Appropriability strategy and how it could strengthen its strategy to have a better protection in the future. Hopefully with this we can get an insight in whether appropriability regime theory only can be used as a theoretic model, or whether it is also usable to explain appropriability of a specific company.

3.1 Data

In order to answer the research question we will be using the following data, retrieved out of secondary data. In the first paragraph Garmin's appropriability mechanisms will be described. In the second part we will examine possible knowledge overflow. After that we will look at market share,

and we will end this chapter with the analysis of the absorptive capacity of TomTom.

3.2 Mechanisms

3.2.1 Nature of knowledge

The knowledge of Garmin is mainly on the field of Global Position Systems. Satellites send out signals which can be used to calculate the positioning on earth quite accurate (+10m) (Masumoto, 1993). A GPS device consists of an antenna to derive this signal, and a computer that calculates the position and plots it on a map. Garmin depends on satellites maintained by the US government. If for some reason the US government decides to stop sharing this signal, satellites break down or there is interference with the GPS signal the business of Garmin will suffer (Garmin, 2004).

The success of the products made by Garmin depends on how good the separate parts function. Garmin products need good software which needs to be user friendly.

Another important factor for a GPS device is a good map because without it the devices will be useless. Garmin does not own its own map producer; the world's largest map suppliers are Tele Atlas N.V., and NAVTEQ Corporation (McGinn, 2007). Both are owned by competitors of Garmin, TomTom and Nokia (Garmin, 2009). Garmin tried to acquire Tele Atlas in October 2007 but lost the case to TomTom in February 2008. NAVTEQ was acquisitioned by Nokia in February 2008 (Garmin, 2007). Garmin currently has an agreement with NAVTEQ, a license to use the maps until 2015 with option to extend through 2019 (Garmin, 2009). Garmin is thus very dependent on its competitor on one of the key factors of success of its products. It would have probably been beneficial for Garmin if it would have been able to acquire one of the big map producers. Also then Garmin could have realized extra profit from licensing the map to others itself.

Next to that Garmin needs a well functioning device with a good antenna for good signal, a correctly working (touch) screen, and for example a good battery.

Most of these features can be considered explicit knowledge. In order to design and manufacture these products possibly substantial R&D budgets are invested. However the result is quite easy to reverse engineer and imitate if not protected sufficiently, and this can save imitators' time and resources. IPR strategy will thus be important.

Tacit knowledge is, like explained in the theory section, more embedded in routines by employees. It can in this case be e.g. the skills that Garmin and its employees have for finding market opportunities. One of the big threats in the PND market is that the market erodes by replacement technologies available on mobile handsets and factory installed systems in cars (Garmin, 2009). Garmin already noticed a maturing market in 2007, but PND was still responsible for 70% of its revenues in 2009. Gross margins on automotive products fluctuate because of product mix, competition and unit volumes and average selling price decline over product life (Garmin, 2009). Garmin started to focus more on its outdoor and fitness segment, where revenues grew. Tacit knowledge can result in a big competitive advantage because it is not easy to copy by imitators. It is difficult to show with the secondary data what Garmin's tacit knowledge is.

3.2.2 Institutional protection

As stated it is important to protect explicit knowledge with IPR's and other institutional protection. Garmin announced in its annual report 2009 that "our intellectual property rights are

important to our operations, and we could suffer loss if they infringe upon other's rights or are infringed upon by others". They state that they rely upon a combination of patents, copyrights, trademarks and trade secrets, confidentiality provisions and licensing agreements to establish and protect IPR's. But also Garmin states that this is no guarantee of competitive advantage (Garmin, 2009).

If we look at patents (as can be seen in appendix B) we see a big growth during the examined years. From 64 US patents in 2001 to over 600 in 2011 (+837.5%). Noticeably is that Garmin only started patenting outside the US in 2006. These patents are patenting products, but also for example ways of mounting, antennas, wireless communication etc. Around 2006 and 2007 Garmin was involved in some court cases, some filed by Garmin itself, but also sued by others. This might show that patenting was too late, or in the wrong country. In 4.3 we will go further on lawsuits.

Trademarks are a way of claiming exclusive properties of products or services. In Garmin's case trademarks are e.g. used on names of products, logo's, and designs. We could not find any infringements of Garmin's trademarks, however Garmin is sued for infringing Nuvio's trademark with Garmin's Nuviphone, and Garmin settled (directionsmag.com, 2008).

Contracts and labor legislation are a difficult topic to find information on without interviews, because mostly they are private. Garmin's annual report state that none of the employees (except four in Brazil (Garmin, 2007) and some in Iceland and Sweden (Garmin, 2008)) are represented by a labor union or covered by collective bargaining agreement, and that it considers its employee relations to be good (Garmin, 2004, 2005, 2006a, 2007, 2008, 2009, 2010).

3.2.3 Human resource management

There is no publicly available information about communication within Garmin, and we could not find other sources about this. About (in)mobility Garmin states in its annual report that its business might suffer if it is not able to hire and retain sufficient qualified personnel, and if they lose their key personnel (Garmin, 2009).

In appendix D a summary of Garmin's employees can be found. Garmin has employed on average around 20-25% of its personnel in R&D functions. This is above average (17.61%) for big an electronics company (Shefer & Frenkel, 2005). There is no distinction made in employees that work in different market segments, but probably some R&D results can be used crosswise.

3.2.4 Practical/technical means

About secrecy, logically, not much can be found. This is not usual information to disclose in public information, because this is mainly of internal importance.

The products of Garmin are all accessible with a computer in order to update, add routes and tracks etc. This makes the product viable for hacking software and maps. Although efforts of trying to protect with product keys, and online access, there are cases known of illegal use of software and maps, which will harm revenues.

3.2.5 Lead time

Garmin realizes that it should be successful in continuous development, introduction or timely manufacture of new products, otherwise demand for the products could decrease (Garmin, 2009). One of the examples of this is the earlier mentioned shift to the outdoors and fitness segment. As can be seen in appendix A, the automotive and mobile segment lost revenues (from around 70% of the total revenues generated to

49% in 2013) and outdoors and fitness grew (to 30% of generated revenues in 2013).

Garmin believes that one of their core competences are their manufacturing capabilities in Shijr, Taiwan, Olathe, Kansas, and Salem, Oregon. Garmin claims to have three advantages with these facilities and their vertical integrated approach; reduced time to market, design and process optimization and logistical agility (Garmin, 2004). Reducing time to market makes Garmin able to move from design phase to finished product in less time, resulting in several industry firsts.

Garmin is busy with continuous development; this is shown by their product range (appendix E). Not only do they from time to time come up with new equipment, but also a lot of revised versions come to market, with some improvements, or new applications on them (Garmin, 2005). In appendix E the number of Garmin products and models is shown. Almost all products have different models or versions. The figures might not show a big amount of introduction of new products, but we should keep in mind that older products are stopped being produced. This is also elaborated by appendix B, which shows the number of product introductions. Most of these changes and differences in models are incremental, but e.g. the launch of the fitness devices could be called radical innovation because it provided a new market and new opportunities. Also Garmin, in 2008, tried to get into the smart phone market, but this was not a success and it stopped producing and selling in 2010.

3.3 Knowledge overflow

It is difficult to analyze knowledge overflow between Garmin and e.g. TomTom. We looked for example at information about employees transferring to competitors; however we could not find results on this.

However we can look at patent cases which give us some information about how the companies think about knowledge overflow.

Feb 2006 Garmin sued TomTom in Wisconsin for infringing 5 patents in "ease of use" technology. TomTom then bought 3 U.S patents from Horizon Navigation Inc. and counterclaimed Garmin. End of 2006, Garmin was able to defense the case were Garmin was sued by TomTom for infringing 3 patents (Garmin, 2006b). Also in the Netherlands a case was won by Garmin (Garmin, 2006c). In 2007 an American judge declared that Garmin has to stop forcing the case, and that patents are not infringed by both companies (Consumerelectronicsdailynews, 2007).

The cases show us that both Garmin and TomTom are using patents as a way of possible defense, and even offensive strategy. By winning cases the companies could block the competitor, and thus creating a competitive advantage.

3.4 Market share

Garmin is according to their annual report 2009 aware of the fact that they have to effectively compete with new and existing competitors and that losing competitive position could result in price reduction, fewer customer orders, reduced margins and loss of market share (Garmin, 2009).

Analyzing market share can be difficult because first of all the market is dynamic, and there are several parties involved. Market growth of one company, does not automatically result in market decline for another. The total market can grow/decline and every company has its share in this.

The market share differs if we look at continents. If we look at 2007, Garmin had 47% of the US market, TomTom 19%. In Europe the case was the other way around, TomTom was

market leader with 38% and Garmin was second with 19% (GPSmagazine, 2008)

Like mentioned before both Garmin and TomTom have been world market leader for some years, and both are facing decline in units sold (Statista, 2014a, 2014b). Also prices have declined radically, from expensive army or executive use, to normal everymen's equipment in a car (McGinn, 2007). We could not find evidence of direct market loss to a specific competitor.

3.5 Absorptive capacity of TomTom

Although this is not the subject of study in this paper, absorptive capacity is of importance here. Information that flows out of Garmin and reaches the market, in some way can be caught by competitors; otherwise it would not be a problem. In this case we will slightly take a look at TomTom, the biggest competitor of Garmin. This can be an interesting subject for further research. (Werner, 2014), is busy with researching absorptive capacity on the TomTom case. However his study mainly focuses on the smart phone applications and big bang irruptions, we will consider this for the whole of TomTom for this study. The study concludes that TomTom was mainly active with R&D as reaction on the market. Ideas about GPS in phones have been there since 1996 (Makino, Ishii, & Nakashizuka, 1996), and e.g. rumors about the first smart phone (the iPhone) have been there since 2002. There have also been other changes in the market, for example companies providing free maps. TomTom did not react on this quickly (Werner, 2014).

4. CONCLUSIONS

4.1 Appropriability mechanisms

4.1.1 Nature of knowledge

The nature of knowledge of Garmin in terms of appropriability mechanisms is not that strong. The lack of a map producer makes Garmin dependent of licensing of map producers, which are competitors. If Garmin would have been able to acquire one of the map suppliers it would have made this mechanism stronger. Further the knowledge of Garmin is mainly on products and GPS technology. The latter is not very difficult and is not patentable, because it is basically a mathematical formula and the use of satellites. Garmin tries to patent some features of the products to try to gain an advantage as opposed to competitors' products. This can be on ease of use, add-ons etc, but the basics of the PND's are quite similar, also for the competitors. This extra's need good protection because they are easy to copy.

4.1.1.1 Institutional protection

In terms of institutional protection we can conclude that Garmin pays great effort in trying to protect its products and ideas. Mainly at first only in the United States, after 2006 it started also with foreign patents, possibly in response to competitors from Europe. Also lawsuits back and forth between competitors show that the industry is busy with protecting its IPR's. According to the statistics of (Hurmelinna-Laukkanen & Puumalainen, 2007) IPR's are not the strongest form of protection, and is not used very much. The IPR's might serve different goals than protection of value, namely short/long-term goals, to block competitors or create value by licensing. An example of this is what Nokia and TomTom do with the map producers they own, they use it themselves for their own products, and create extra value by licensing to others.

On contracts and labor regulations we cannot state much. Those mechanisms are more of a supportive kind, making it possible to have secrecy for example, and go hand in hand with HRM.

We can conclude that Garmin's efforts on institutional protection are good; however this might not be the most effective mechanism according to theory (Cohen & Levinthal, 1990).

4.1.1.2 HRM

About HRM not much is stated in the secondary sources, the annual reports we used. About employees we can state that the number of employees rose significantly until 2007 (appendix D) and a big share of those are in R&D (about 25%). This is in line with Garmin's statement to be an innovative company.

4.1.1.3 Practical/technical means

Because the practical and technical means are quite internal factors it is difficult to examine this. Garmin does use keys on its products and map in order to protect the software and maps from illegal use.

4.1.1.4 Lead-time

The mechanism lead time goes hand in hand with Garmin's R&D department, and Garmin realizes that this is their main selling point. One of the examples given is the change to the outdoor and fitness segment, in order to replace the declining segment of PND's.

One of the signs Garmin is doing well on R&D is their ranking in the Ocean Tomo 300 patents index (OceanTomo). Ocean Tomo is an industry leading array of financial products and services related to intangible assets.

We tried to find further information on market introduction, announcements, and entry. However with the secondary data this was not possible.

4.1.1.5 Summary

This all results in the following summary of the appropriability strategy of Garmin in figure 3.

Appropriability mechanism		++	+	+/-	-	--	Interviews needed
Nature of knowledge	<i>tacit</i>		<i>Ability to find new market segments</i>		<i>Mainly explicit knowledge, easy to copy</i>		
	<i>(codified)</i>					<i>No own map supplier, dependent of competitor</i>	
Institutional protection	<i>IPRs</i>		<i>High efforts on IPRs</i>		<i>Cost of lawsuits</i>		
	<i>contracts labor legislation</i>				<i>Too late patenting outside US</i>		*
HRM			<i>High % of employees in R&D</i>		<i>No labor unions on most employees</i>		*
	<i>communication (im)mobility</i>						*
Practical/technical means	<i>passwords secrecy acces restricting etc.</i>				<i>Productskeys</i>		*
							*
Lead time	<i>market entry</i>		<i>Noticed maturing market PND > switch to outdoor & fitness</i>				*
	<i>continuous develement</i>		<i>Big R&D department /staff</i>				*

Figure 3: Summary of appropriability mechanisms

4.2 Knowledge overflow

In terms of knowledge overflow we cannot, with the used sources, claim that TomTom directly copied ideas of Garmin. However we can state that TomTom could have been able to use information that was in the market generated by Garmin.

4.3 Market share

We can conclude that the total market size is declining, which can be explained by the rise of the smart phones (Cellularnews, 2009). This is an important fact for Garmin and its competitors, because they have to start (or already did) to look at other segments or business models. We did not find info on losing market share because of knowledge overflow.

4.4 Absorptive capacity

From the research of (Werner, 2014) we can conclude that TomTom derived a lot of ideas out of the market. So it could be possible that e.g. Garmin started selling a certain product, and that TomTom noticed demand in the market (in Europe) for this, and developed their own products to sell. On the other hand TomTom was not very quick with some ideas, like their smartphone application. A further study on absorptive capacity of TomTom could give insight on this.

5. DISCUSSION

In the discussion we want to end this paper with some recommendations and limitations of this study. One of the big limitations of this study is working with secondary data. Interviews might answer questions about HRM, secrecy and practical and technical means. The last two are considered important mechanisms by the (Hurmelinna-Laukkanen & Puumalainen, 2007) results. Also on the other mechanisms it might provide another angle because we now needed to work with information that was provided by Garmin, which they by law had to declare. There are certain rules for writing a annual report which need to be followed when being a listed company. Also e.g. lead-time was difficult to research, while this can provide important clues. It was not possible to collect the data about market entry and introduction. It would have been useful to be able to calculate average time from idea to announcement and to introduction of the product. This might show that the R&D department has become faster, or that a different strategy is used (e.g. longer secrecy, late announcement). For future research trying to derive interviews at Garmin would definitely be beneficial for this study.

Another limitation is that it is difficult to measure the reasons for the loss or gain of market share. Market share can easily been explained by a fast growing market for example. The difference in sales in the US and Europe can have a regional explanation, and we do not know if Garmin was able to tackle this market more.

Also a limitation is that the study of (Hurmelinna-Laukkanen & Puumalainen, 2007) is tested on Finnish companies from numerous types. New research on the electronics sector might show a difference in mechanisms used. Also because Garmin is active around the globe, regional differences might be big. E.g. Taiwan and the United States presumably differ great on law etc.

Despite this, we hope to show with this article that the appropriability regime can be a usable tool to study a company defense, look at its past, or try to make its future protection more proficient. We do not think this model can be used to make calculations about different companies to be able to compare them, because there are so many factors that are not easy to make measurable in ordinal way. However we think this model can be used, with enough data (inside and market), to

partly explain the position in the market and to find weak spots in the company's defense mechanisms. Because appropriability depends on mechanisms available, company segment, and e.g. country dependent variables, no best solution for all circumstances can be made. This is why a tool that helps to map appropriability can be very useful. For this use not all information is needed, but a more complete view will be best to find weaknesses. We hope to see that future research, with more company data, will show that the appropriability regime can provide with useful information to strengthen appropriability, and create awareness with managers that appropriability is dynamic and needs rethinking all the time.

6. ACKNOWLEDGMENTS

I would like to gratefully thank my main supervisor Drs. P. Blik, my second supervisor Dr. Ir. S.J.A Löwik of the University of Twente for their guidance during this last step of the Bachelor program. Also I would like to thank my associate students for our group work and specially P. Werner for his contribution and help on absorptive capacity.

7. REFERENCES

- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
- Bizjournals. (2007). Garmin overtakes TomTom as GPS market leader. *Bizjournals*.
- Cellularnews. (2009, 1-9-2009). Smartphones to Surpass PNDs in Navigation Market in 2014. *Cellular News*.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A new perspective on learning and innovation. *Administrative science quarterly*, 35(1).
- Consumerelectronicdailynews. (2007). Court Dismisses Garmin, TomTom Patent Suit. Retrieved from http://www.cedailynews.com/2007/04/court_dismisses.html
- Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35(12), 1504-1511.
- directionsmag.com. (2008, 28-02-2008). Nuvo Announces Trademark Infringement Lawsuit Against Garmin International, Inc. *Directions magazine*.
- Garmin. (2004). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>
- Garmin. (2005). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/2005/Annual%20Report>
- Garmin. (2006a). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>
- Garmin. (2006b). Garmin Obtains Complete Victory on TomTom Patents, Will Pursue Own Patent Claims Against TomTom. Retrieved from <http://www8.garmin.com/pressroom/corporate/122306.html>
- Garmin. (2006c). Garmin Wins Dutch Lawsuit Brought by TomTom. Retrieved from <http://www8.garmin.com/pressroom/corporate/110206.html>
- Garmin. (2007). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>
- Garmin. (2008). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>

- Garmin. (2009). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>
- Garmin. (2010). Annual Report Retrieved from <http://www.annualreportowl.com/Garmin/Annual%20Reports>
- GPSmagazine. (2008). GPS Brands Market Share Data for 2007, 2014, from http://www.gpsmagazine.com/2008/05/gps_brands_market_share_data_f.php#U3nZzChAEqg
- Hurmelinna-Laukkanen, P., & Puumalainen, K. (2007). Nature and dynamics of appropriability: strategies for appropriating returns on innovation. *R&D Management*, 37(2), 95-112.
- Hurmelinna-Laukkanen, P., Sainio, L. M., & Jauhiainen, T. (2008). Appropriability regime for radical and incremental innovations. *R&d Management*, 38(3), 278-289.
- Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic management journal*, 13(1), 111-125.
- Levin, R. C., Klevorick, A. K., Nelson, R. R., & Winter, S. G. (1987). Appropriating the returns from industrial research and development. *Brookings papers on economic activity*, 3, 783-831.
- Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: an analysis of interfirm differences in efficiency under competition. *Bell Journal of Economics*, 13(2), 418-438.
- Makino, H., Ishii, I., & Nakashizuka. (1996). *Development of navigation system for the blind using GPS and mobile phone combination*. Paper presented at the 18th Annual International Conference of the IEEE.
- Masumoto, Y. (1993). US Patent No.: P. E. Corporation.
- McGinn, D. (2007). Can Garmin Maintain GPS Lead?, *Newsweek*. Retrieved from <http://www.newsweek.com/can-garmin-maintain-gps-lead-96469>
- OceanTomo. Ocean Tomo 300® Patent Index website Retrieved 16-6-2014, 2014, from <http://www.oceantomo.com/productsandservices/investments/indexes/ot300>
- Polanyi, M. (1966). Profit from innovation. A comparison of Swedish and Japanese intellectual property management. *Royal Swedish Academy of Engineering Sciences*.
- Polanyi, M. (2012). Personal knowledge: Towards a post-critical philosophy Retrieved from <http://books.google.nl/books?hl=nl&lr=&id=NdcnAgAAQBAJ&oi=fnd&pg=PR7&dq=Polanyi,+M,+%281958%29+Personal+Knowledge:+Towards+a+Post-Critical+Philosophy.+University+of+Chicago+Press.+&ots=TjmmwVUInC&sig=5n6sIUpBfINpvCtpvgjk1rYgeXI#v=onepage&q&f=false>
- Shefer, D., & Frenkel, A. (2005). R&D, firm size and innovation: an empirical analysis. *Technovation*, 25(1), 25-32.
- Statista. (2014a). Portable navigation devices (PND) sold in Europe* from 2007 to 2013 (in millions). Statista Retrieved 10-6-2014 <http://www.statista.com/statistics/217933/market-size-of-pnds-in-europe-since-2007/>
- Statista. (2014b). Worldwide PND and car navigation market size forecast from 2005 to 2015 (in 1,000 units) Retrieved 10-6-2014 <http://www.statista.com/statistics/218118/global-pnd-and-car-navigation-market-size-since-2005/>
- Teece, D. J. (1995). Firm organization, industrial structure and technological innovation. *Consortium on Competitiveness and Cooperation*, 95-8.
- Teece, D. J. (1998). Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets. *California Management Review*, 40(3), 55-79.
- Werner, P. (2014). *Absorptive capacity characteristics needed for the big bang disruption of free smartphone navigation applications*. Bachelor Thesis. University of Twente, Enschede.

8. APPENDIX

Year	Net sales	% change	total units (*1000)	% change in units	Consumer	% of total net sales	Aviation	% of total net sales	Marine	% of total net sales	Outdoor/Fit ness	% of total net sales
2000	345.8	.	.	.	230.2	66,57%	115.6	33,43%	.	.	.	.
2001	369.1	6,74%	1331	.	263.4	71,36%	105.8	28,66%	.	.	.	.
2002	465.1	26,01%	1557	16,98%	350.7	75,40%	114.5	24,62%	.	.	.	.
2003	572.9	23,18%	2066	32,69%	452.4	78,97%	120.6	21,05%	.	.	.	.
2004	762.5	33,09%	2306	11,62%	591.0	77,51%	171.5	22,49%	.	.	.	.
2005	1,027.8	34,79%	3028	31,31%	798.6	77,70%	229.2	22,30%	.	.	.	.
2006	1,774.0	72,60%	5400	78,34%	1,089.1	61,39%	232.9	13,13%	166.6	.	285.4	.
2007	3,180.3	79,27%	12300	127,78%	2,342.2	73,65%	295.0	9,28%	203.4	6,40%	339.7	10,68%
2008	3,494.1	9,87%	16900	37,40%	2,538.4	72,65%	323.4	9,26%	204.5	5,85%	427.8	12,24%
2009	2,946.4	-15,67%	16600	-1,78%	2,054.1	69,72%	245.7	8,34%	177.6	6,03%	468.9	15,91%
2010	2,689.9	-8,71%	16000	-3,61%	1,668.9	62,04%	262.5	9,76%	198.9	7,39%	559.6	20,80%
2011	2,759.0	2,57%	16000	0,00%	.	58,00%	.	10,00%	.	8,00%	.	24,00%
2012	2,716.0	-1,56%	.	.	.	55,00%	.	11,00%	.	7,00%	.	27,00%
2013	2,632.0	-3,09%	.	.	.	49,00%	.	13,00%	.	8,00%	.	30,00%

Appendix A: Net sales of Garmin 2000 till 2013

Case Summaries^a

Year	Total new products released*	Automotive /mobile	New Patents	Total Patents US	Foreign patents	Total patents worldwide	Patents pending US	Foreign patent pending	Trademarks US	Foreign trademarks	Total trademarks
1 2001	25	.	.	.	.	.	.	.	.	.	.
2 2002	22	18	33 US	97	.	.	100+	.	.	.	.
3 2003	16	16	37 US	134	.	.	145	.	.	.	.
4 2004	50	35	.	.	.	.	.	.	.	.	.
5 2005	55	40	.	257***	.	.	171	.	.	.	.
6 2006	70	.	.	254	4	.	160	11	.	.	.
7 2007	.	.	.	331	42	.	190	32	81	162	.
8 2008	60	.	.	381	42	.	143	36	95	191	.
9 2009	.	.	.	.	.	400+	.	.	.	.	250+
10 2010	.	.	.	.	.	450+	.	.	.	.	300+
11 2011	.	.	.	.	.	600	.	.	.	.	400+
12 2012	.	.	.	.	.	***	.	.	.	.	.
13 2013	.	.	.	.	.	.	.	.	.	.	.

a. ***all garmin products not only navigation

***High ranking by business week

***Ocean TOMO 300 patent index

Appendix B: Garmin Patents and trademarks

Year	R&D expenditure (millions)	Revenue	net income	% of revenue	% of net income
1997	12,3	161,3	35,1	7,63%	35,04%
1998	14,9	169,0	35,2	8,82%	42,33%
1999	17,3	232,6	64,2	7,44%	26,95%
2000	21,8	345,7	105,7	6,31%	20,62%
2001	28,2	369,1	113,4	7,64%	24,87%
2002	32,2	465,1	142,8	6,92%	22,55%
2003	43,7	573,0	178,6	7,63%	24,47%
2004	62,0	763,0	206,0	8,13%	30,10%
2005	75,0	1028,0	311,0	7,30%	24,12%
2006	113,0	1774,0	514,0	6,37%	21,98%
2007	159,0	3180,0	855,0	5,00%	18,60%
2008	206,0	3494,0	773,0	5,90%	26,65%
2009	238,0	2946,0	704,0	8,08%	33,81%
2010	277,0	2690,0	585,0	10,30%	47,35%
2011	299,0	2759,0	521,0	10,84%	57,39%
2012	326,0	2716,0	542,0	12,00%	60,15%
2013	365,0	2632,0	612,0	13,87%	59,64%

Appendix C: Garmin's R&D expenditure

Garmin Staff^a

Year	Total staff	R&D	US	Canada	Taiwan	Uk	Europe	Other global
2001	1329	50 new*	.	.	.	.	.	.
2002	1575	67 new*	.	.	.	.	.	.
2003	2021	150 new**/*	.	.	.	.	.	.
2004	2484	567	1111	.	1311	62	.	.
2005	3034	709	1322	.	1628	84	.	.
2006	4751	970	1728	53	2807	.	160	3
2007	8434	2140	2443	67	5444	.	475	5
2008	8919	1738	2896	76	5253	.	644	50
2009	8437	1969	2948	68	4727	.	623	71
2010	8897	2340	3470	72	4419	.	725	211
2011	.	.	.	.	.	.	.	.
2012	.	.	.	.	.	.	.	.
2013	.	.	.	.	.	.	.	.

a. *no figures on total of R&D staff

**Of Which 50 aviation experts of the acquisition of UPS, later named Garmin AT

Appendix D: Garmin's staff

Year	PND products/automotive/mobile	Outdoor/fitness	Marine networking	Marine other	Sounder	consumer communication	aviation handheld	Aviation build in
2001								
2002								
2003								
2004	13 (36)			8 (24)	3 (12)	2 (4)	5	21 (24)
2005	14 (59)		10 (14)	4 (17)	2 (16)	1 (5)	6	22 (25)
2006	7 (32)	7 (30)	10 (14)	4 (34)	**	**	6	20 (25)
2007	6 (40)	8 (56)	12 (42)	4 (15)	**	**	5	24 (27)
2008	4 (31)	10 (45)	12 (43)	4 (13)	**	**	8	23 (25)
2009	5 (33)	8 (37)	15 (39)	5 (24)	**	**	6 (9)	26 (29)
2010	4 (58)	9 (34)	13 (37)	6 (33)	**	**	4 (7)	30 (33)
2011					**	**		
2012					**	**		
2013					**	**		

Appendix E: Garmin product

