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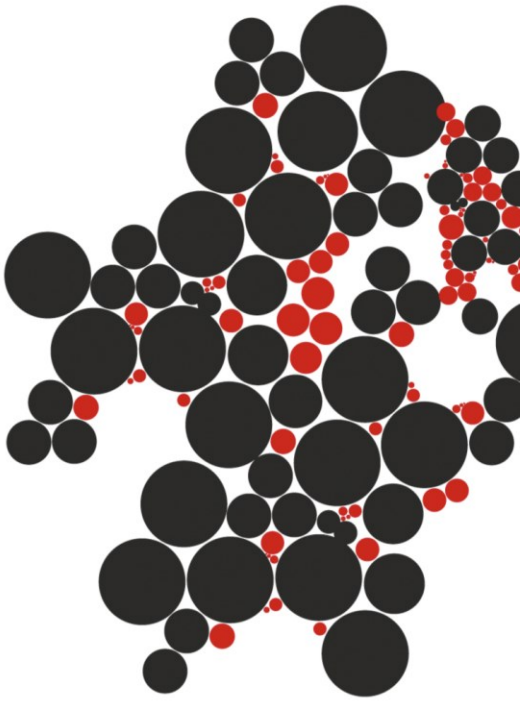

USING THE PATENT MANAGEMENT MATURITY MODEL TO ASSESS THE PERFORMANCE OF STRATEGIC PATENT MANAGEMENT IN LARGE PATENT-INTENSIVE COMPANIES: A PILOT STUDY

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Master thesis business administration

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Preface

This research is the conclusion of the Master Business Administration at the University of Twente. While searching for a suitable assignment I got in touch with Dr. A.H. van Reekum. After some discussion it was decided to take another look at the Patent Management Maturity Model (PMMM). This model, developed by van Reekum (1999) himself, can be used to explore the maturity of different patent functions. But what does the maturity of different patent functions say about the performance of patent management? This question is at the core of this research. It is my hope that this report may provide useful information on both the PMMM and patent management performance, contributing to both the literature and future research.

I would like to take this opportunity to use to thank a number of people without whom this report could not be established. First I would like to thank Dr. A. H. of Reekum for the good support and cooperation during this research. I would also like to thank Petra Hoffmann for her role as second supervisor, she has been a great help in completing this study. I would also like to thank the Dutch work organization for patent information (WON) for distributing questionnaires amongst their members. The results from this survey are crucial in this research. Al last, I would like to thank Emely, my family and friends for being there for me during this research.

Dexter Nijmanting

Enschede,

12th of February 2015

Management summary

The starting point of this pilot study is the Patent Management Maturity Model (PMMM). This model basically rearranges strategic patent practices into eight patent functions. The following functions can be distinguished: Incentive, Appropriation, Protection, Dissemination Liability, Portfolio, Asset and Performance Indicator. A strategic planning tool is used to explore the maturity of those eight functions. Managers can use this information to assess the current patent management practice for making a next step towards a more active use of patents (Kern & Reekum, 2007).

In this study, an attempt is made to use the PMMM to measure the performance of strategic patent management for patent-intensive companies from a different angle. The main assumption is that large patent-intensive companies with mature patent functions also score higher on the performance of those functions. To explore the performance of patent management a literature study was done were both the relevant aspects of the PMMM and patent management performance form the most prominent factors. Within the model, patent functions are clearly defined, and for each of these functions performance indicators were selected based on existing theory. The result is a conceptual model where the maturity of patent functions is the independent variable, and the performance of the same functions is the dependent variable. Controlling for the proposed relationships are firm size, age and sector.

Another objective is to explore the conceptual model in the real world with an empirical study. Therefore, a questionnaire specific for the maturity and performance measure has been constructed based on an operationalization of the theoretical framework. These questionnaires were used for a survey amongst patent-intensive companies. For the sample, 55 companies were targeted through a Dutch work community for patent information specialists (WON) which roughly 70% consist of companies with more than 500 employees, of which 20 companies responded. Because it is a pilot study, more than one method for gathering data was used. Senior patent specialist of two large multinational were asked to comment on the questionnaires. Due time restrictions it was not possible to adapt the questionnaires before the survey.

The descriptive results from the survey provide valuable information about the maturity and performance of the companies involved regarding the eight patent functions. Based on averages, it is possible to compare the maturity for each function. For maturity the planning attitude scale was used (from inactive to pro-active), and for performance a generic performance was selected (from poor to excellent). Although not a perfect fit, it does present someway to compare both sets. Interestingly enough, all but the liability function show parallels on maturity and performance (e.g. for the incentive function the maturity score is ‘pro-active’ and the performance score is ‘good’).

After gathering the descriptive results a reliability analysis was done. The conclusion of the analysis is that there are no variables for both concepts that are both reliable enough for further statistical analysis. Ideally it would have been best to find a correlation between each of the variables for maturity and performance, but this is not possible with the current results. Unfortunately this means that the research question remains unanswered at this point.

However, because this is a pilot study the main objective is to construct a model were both the relevant aspects of the PMMM and patent management performance are the most prominent factors.

Therefore it is recommendations for future research are an indispensable part of the study. From the results of the reliability study the biggest recommendation is to test the relationships proposed in the research question. This means statistically test the relationship between the maturity and performance for patent functions. Basically this means a larger sample. Other general recommendations are:

- Account for generalization of research results.
- Improve the validity of questionnaire items. So, make sure questionnaires are more suited for larger companies with employees that have a more complete understanding of patent management systems.
- Account for function and position of employees within the company.
- Assess sector and/or national differences.

These are of course general recommendations that reflect on both questionnaires as a whole. However, improvements can also be made on a functional level. A first attempt has also been made to incorporate some of these recommendations into an improved version of the performance questionnaire.

The road to this ambition has fortunately provided a lot of new information on how to measure dimensions of patent management. So far there has little research that explicitly tackles the patent management performance issue on a different level. Kern and van Reekum (2007) summarize the efforts made in this pilot study by stating the following: “operationalization of the framework provides a rare conceptualization of the organization of strategic patent management, leveraging knowledge of large companies’ practices”. In this lies the value of this study.

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1. Introduction

In this study, an attempt is made to develop a model to measure the performance of strategic patent management for patent-intensive companies in a different way. The starting point of this quest is a model developed by van Reekum (1999). This model, known as the Patent Management Maturity Model (PMMM), is in its essence a strategic patent management typology (van Reekum, 1999). The model basically rearranges strategic patent practices into eight patent functions. A strategic planning tool is used to explore the maturity of those eight functions. Managers can use this information to assess the current patent management practice for making a next step towards a more active use of patents (Kern & Reekum, 2007).

But how is the link between the maturity of patent functions and developing a model to measure the performance of patent management made? As mentioned above, the starting point for this thesis is the PMMM. Managers can essentially apply the model it to survey the actual use of patents in order to identify potential for improvement in patent exploitation (Kern & Reekum, 2007). However, an active use of patents does not necessarily say something about the performance of patent management. In conversations with one of the developers of the PMMM it became clear that adding a form of performance measure would be valuable addition to the original model. In this way mangers can possibly measure if their policy improving the use of patents in their organization actually had any effect. For example, the PMMM assesses a company's position on employees who help in commercializing research results. You can imagine that companies with a proactive attitude towards this position would also want to know if employees actually contribute in some way to the commercialization process, as a result of that policy. From this line of thought the idea was formed to take a closer look at the performance of patent management.

The difficulty however lies in the identification and the definition of both the many aspects of patent management as the indicators that can be used to measure performance. However, a different way of looking at the performance issue can provide significant new insights in the patent management field. As described above the PMMM follows a functional approach. This approach provides a perfect starting point for researching the performance of patent management from a different angle. In developing a model and measuring patent management performance the value of this research can be found. However, given that the PMMM forms the starting point for the performance measure, the link between these concepts is also explored.

In this paragraph relevant background, an introduction to the original model, scope of the research, problem definition, research questions and the structure of this thesis are presented.

1.1 Background

In 1999, van Reekum published his work on a model for managing the creation of knowledge. This work forms the foundation on which the PMMM is build. The red line through this paper is management of innovation in the pharmaceutical industry. Typically, innovation can be seen as a process of theoretical conception, technical invention and commercial exploitation (Trott, 2008). In this respect, patents are invaluable for firms active in many types of industries today because they provide the exclusive right to commercialize an invention, and prevent others from exploiting your invention in a particular area.

Recognizing the importance of patent management Kern & van Reekum (2007) developed the PMMM. This model was tested by doing empirical research amongst more than 250 SME's in the Dutch pharmaceutical industry. Both the authors felt that their typology was best suited for SME's. However, they realized after their study that SMEs were essentially to 'small' to produce significant results on all the functions. To produce significant results, they actually needed larger companies with more dedication to the different patent functions. Larger, often multinational companies have significant patent strategies, portfolio's and sometimes even entire divisions dedicated to patent management. To fully test their model and produce more significant results in the process, Kern & van Reekum (2007) proposed that their model should be tested amongst larger companies with a dedicated patent management system. In the final paragraph of that study the question was raised if the maturity of different patent functions has a relationship with the actual performance of companies operating in different sectors.

But how can you measure the performance of patent management? To measure the performance of patent management, authors such as Narin & Noma (1987) looked at statistical data such as patent citation data, development budgets, scientific productions and technological strength. This traditional of performance measurement is done at a very high level of aggregation (e.g. R&D expenditure, number of patents).The problem with many of these measures is that you cannot trace them back to specific patent activities. For example, it is difficult to find a direct relationship between rewarding researchers for the involvement in patenting and technological strength. A possible solution lies in the PMMM itself. As discussed briefly in the introduction the model bundles different patent practices into functions. The idea is that a functional approach gives a different gives a different perspective on patent management. Therfore, this research will focus on the performance of the patents functions that are at the core of the PMMM. This approach is relatively new in the field. And it can possibly make a contribution to the field of patent management.

In next section of this chapter, some of the concepts of the PMMM are discussed to get a first impression.

1.2 The Patent Management Maturity Model

As mentioned above the starting point of this assignment is the PMMM. Important to note that this model essentially a planning tool for strategic patent management. The model clearly defines the functions patents have, and each function consists of the relevant strategic patent practices. The model gages the maturity of both patent practices and corresponding functions. The maturity of the different functions combined can be seen as an advice to the management which direction is firm is going regarding strategic patent management.

But how is the concept of maturity measured? Maturity is measured based on Ackoff's categories of strategic planning attitudes (Ackoff, 1981). From this theory Kern and van Reekum (2007) developed their own four attitudes. Comparable to Ackoff (1981), these planning attitudes represent an increasing level of activeness, which are: *Inactive, Reactive, Active* and *Proactive*. These planning attitudes indicate the level of maturity. So how higher the activity level, how higher the maturity, is the argument. Because in this study the terms 'patent practice', 'patent function' and 'patent management' are frequently used is good to keep in mind which level these refer to. These levels are depicted in figure 1. To summarize, a set of patent practices (e.g.

giving rewards, position on commercialization etc.) forms a patent function (e.g. incentive function). All the eight functions together form a picture of patent management in an organization. So, mature practices say something about the maturity of a specific function. The maturity of all the functions together says something about the maturity of patent management in an organization. Maturity is measured by a strategic planning attitude, so you have practices, functions and patent management that are measured a scale from inactive to pro-active. The focus of this study lies on the functional level.

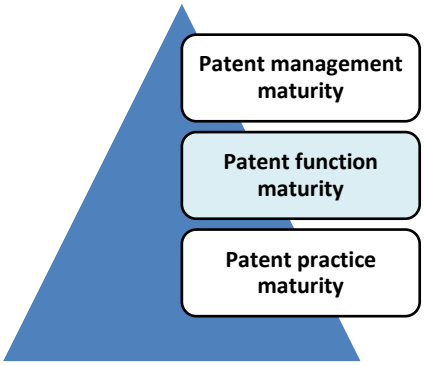

Figure 1. Levels of maturity.

The eight patent functions that are subjected to this planning attitude are at the heart of the model and are divided in two categories; the inherent functions and the attributed functions. The inherent functions are the functions of patent as intended by the designers of the patent system. The following functions can be distinguished: *Incentive, Appropriation, Protection* and *Dissemination*. The attributed functions are the functions, other than the inherent functions, assigned to patents by use in the business (Kern & Reekum, 2007). These are*: Liability, Portfolio, Asset* and *Performance Indicator* (van Reekum, 1999). These are typically functions that management attributes to patents for corporate purposes a basis for planning activities in order to materialize them (Kern & Reekum, 2007). This functional approach will be the start from which the performance measure will be built. In the next chapter a complete overview of the PMMM will be presented.

1.3 Scope

One of the terms frequently used in this research is 'planning attitude'. In this study, this term refers to a way to indicate the maturity of patent management. As most planning tools do, a planning attitude says something about making choices between alternatives, and can be therefore be seen as a decision-making activity. Because the idea is that efforts made by management must evaluated in the light of its ultimate effect on the outcome of decisions, the research falls under the *decision-making process* (Drury, 2008, p. 8). This process has basically two stages: planning and control (often referred to as the planning and control cycle). The control process is the process of measuring and correcting actual performance to ensure that the alternatives that are chosen and the plans for carrying them out are implemented (Drury, 2008, p. 8).

In an ideal situation plans are made and work is done, followed by a systematic measurement and evaluation of the activities. Because the maturity of patent practices is measured on a planning scale, it basically gives a reflection of a company's policy regarding patent management. To measure the performance

of patent management is basically a way to check to the planning attitude towards these practices. The paradigms discussed above are presented here to put this study into perspective. Measuring the maturity and performance of patent management practices and functions can be a way for managers to evaluate the performance of patent management on a different level.

1.4 Research problem

Basically, the main issue is two-fold. The most important issue is that although some research has been done into patent management, few attempts have been made to find a set of indicators that measure the performance of strategic patent management on a lower level of aggregation. Although many large scale companies operating in technological advanced sectors will probably have many patent management activities, it is difficult to measure how these activities actually perform. According to Trott (2008) any firm working in the science intensive industry, the whole process of developing a product is based on specific abilities that allow companies to commercialize inventions. From this you would think that companies with mature patent functions will also score high measure of performance for those functions. As described in the introduction, the PMMM bundles patent management practices into functions. The main challenge of this research is therefore to find a performance measure for each of the patent functions of the PMMM, and if possible, to see is there is a connection between each of the functions regarding maturity and performance. This process can in return say something about patent management as a whole.

The second problem is that the original research into the PMMM was done over a decade ago amongst SME's. As Kern and van Reekum (1999) both concluded, the results could be more significant if empirical research was done amongst companies that use patent more intensively. The idea is that these companies will have more mature strategic patent management. A new investigation of the model can answer questions about the relevance and usability of the model itself. The process will lead to recommendations and present contributions to the PMMM. Researching a broader scope of companies also raises the question if the characteristics of a firm will have an influence on the relationship between maturity and performance. It is important to distinguish these characteristics that may influence the proposed relation.

1.5 Objectives

The objective is to construct model were both the relevant aspects of the PMMM and patent management performance are the most prominent factors. This means that within the model, the eight patent function need to be clearly defined, and for each of these functions performance indicators must be selected from theory. The goal is to find indicators per patent function to measure the performance of that function. Because from the PMMM there is a strong focus on the eight functions, this level will be used for the performance issue as well (see figure 1). This research design implies that there is a connection between maturity and performance. The basic assumption is that companies with mature patent functions will also score high on the performance of that function.

The second objective is to test that new model in the real world with an empirical study. Therefore, a questionnaire specific for the performance measure must be constructed. For the PMMM a questionnaire

already exists. These questionnaires can be used for survey amongst patent-intensive companies. In this way comments can be made on the maturity and performance of patent functions of the companies involved. Ideally, the results from researching the PMMM and a patent management performance measure can say something about the relationship between each other.

Equally important is that the results reflect on the theory and methods used. In a pilot study the results must also include implications for future research. Therefore, the third objective is to comment on the theory, but especially to make recommendations for improving the questionnaires. The idea is that the model, questionnaires and corresponding recommendations can be used in further research into this topic.

1.6 Research questions

Based the objectives mentioned above, the following research question is formulated to guide this research: "*Do companies with mature patent functions also score higher on the performance of those functions?"* The decision is made here to choose for an explanatory research question. This is done to provide this thesis with a clear sense of direction and to come as close to a model and method to measure the performance of patent management now and in the future. To answer the main question, several sub questions can be drafted to support it:

1. *What are the most important aspects of the PMMM?* It is important to distinguish the most important aspect of the PMMM, since the individual patent functions will form the independent variable in the conceptual model. This will be discussed in the literature review.
2. *How can patent function performance be defined?* It is important to distinguish the most important aspects of the performance measure, since it will form the dependent variable in the conceptual model. This will be discussed in the literature review.
3. *What factors influence the relationship between the dependent and independent variables*? Specific firm characteristics are crucial when it comes to patent management. It is important to dig deeper in the characteristics that may influence proposed relations. This will be discussed in the literature review.
4. *How can the key concepts be measured?* In a study were a conceptual model is proposed it is essential to explain and argue how the different variables are transferred to measurable items. These features will be discussed both in the literature review as well as the methodology section.
5. *What is the effect of the maturity of patent functions on the performance of the functions?* When the empirical study is done, conclusions have to be drawn from the gathered data. It is important to display the results for the response group, and make an attempt to investigate the relationship between the variables in the model.
6. *What are the most significant recommendations for future research?* Hopefully recommendations to the model and method can be used as a basis for future research into this topic.

1.7 Structure

In table 1 below the structure of this research is presented.

Structure	***Contents***	***Structure***	***Contents***
Chapter 1	Introduction Historical perspective. Scope. Problem & objectives. Research questions and structure.	Chapter 4	Response & representativeness Interview results Descriptive results Comparing subsets Reliability en correlation
Chapter 2	The PMMM Patent function performance. Firm characteristics. Conceptual model Operationalization.	Chapter 5	Conclusions Discussion Recommendations
Chapter 3	Research design Target group & sample Data collection & analysis Validity		

Table 1. Research overview and structure.

2. Theoretical framework

In this chapter the theoretical framework of this study will be presented. The two most important variables of this study are discussed and explored here. As explained in the introduction the independent variable is the maturity of patent functions. This variable is based on the PMMM of which the key concepts are discussed here. The dependent variable is the performance of patent functions. For the same functions highlighted in the PMMM a literature review is done to explore which indicators should be used for each individual function. You would expect of course that there are factors that influence the relationship between these variables. Therefore, the effects of firm characteristics are taken into account and presented in this framework. In the last section of this chapter the conceptual model, hypotheses and operationalization are discussed.

2.1 Measuring patent function maturity

The PMMM measures the maturity of patent functions. Policy makers can apply it to survey the actual use of patents in order to identify the potential for improvement in patent exploitation. Managers of these organizations can use it to evaluate the current patent management practice for taking the next step towards a more active use of patents (Kern & Reekum, 2007). The model basically has two major elements. The first element is the four planning attitudes that are used to measure the maturity of patent practices and patent functions. The second element is patent practices that are bundled into eight functions. These eight functions can be divided into inherent functions and attributed functions. In this paragraph both elements are highlighted, starting with the strategic planning attitudes.

2.1.1 Attitudes for assessing patent management maturity

Based on Ackoff's (1981) categories of strategic planning attitudes, Kern and van Reekum developed four attitudes that are applicable in the strategic patent management practice. These four planning attitudes can be applied to eight patent functions that can roughly be divided into intended or unintended by the designer of the patent system. The most important aspect of these strategic planning attitudes is that they represent an increasing level of activeness, which is: *Inactive, Reactive, Active* and *Pro-active*. These planning attitudes indicate the level of maturity. This means that maturity of each patent practice says something about the maturity of a particular function, which in turn says something about the maturity of the strategic patent management as a whole. In this study however, there is a strong focus on the patent function level. In table 1 these strategic planning attitudes are presented with a brief description. These descriptions are adapted from the work of Kern and van Reekum (2007), and show how the activity levels correspond with views on patent management.

Strategic planning attitude	**Description**
Inactive	No initiative in identifying the relevant innovation environment. No IPR policy. Interaction with third parties on a (co)incidental basis. No systematic use of external proprietary Information.

Strategic planning attitude	Description
Reactive	Adapting for the survival of the company as it is. Focus on in-house technological capabilities and exploitation based on competitors. Technology is the primary source of change. IPR policy based on protection.
Active	Scanning the innovation environment. Technology and market are sources for change. Proprietary information used to identify potential partners. Patents are actively enforced.
Pro-active	Developing options arising from existing and future knowledge. Intellectual property is a collective responsibility. Science, technology and (potential) buyers' needs are sources of change.

Table 2. Overview of strategic planning attitudes adapted from Kern and van Reekum (2007).

These corporate strategic planning purposes and a corresponding attitude are considered an indispensable tool for survival in a business environment (Kern & Reekum, 2007). In the next section the patent functions are explored.

2.1.3 Patent inherent functions

The inherent functions are the functions of patents as intended by the designers of the patent system (Kern & Reekum, 2007). These functions are designed to create knowledge.

Patent inherent functions	Description	Focus
Incentive	This function represents the patent as an input motivator to R&D efforts.	Employee contribution to commercialization. Employee rewards.
Appropriation	This function represents the patent as a mechanism providing functional exclusiveness to an invention.	Patent initiative. Regular patent meetings. Patentability of research proposals. IP defined in contracts. Secrecy/publication regulation.
Protection	This function represents the patent as the legal ability to exclude others from gaining returns on investments the proprietor made to create the invention.	Infringement prevention. Fighting infringement. Litigation decisions.
Dissemination	This is about the patent as a source of information open to rivaling companies (as a consequence of being a publication), often inducing 'circumvention'.	Patent information usage. Patent information dissemination.

Table 3. Overview of patent inherent functions adapted from Kern and van Reekum (2007)

In table 3, a description of all the patent inherent functions can be found. Also, a column is added which contains the most important focus within a particular function. By adding this information you can clearly see how the questionnaire for measuring maturity is designed and structured. These specific focus points each correspond with an item in the maturity questionnaire designed van Reekum.

A more elaborate description of the inherent functions can be found in the work of Kern and van Reekum (2007). In the next section the patent attributed functions are discussed.

2.1.4 Patent attributed functions

The attributed functions are to be considered as interpretations of the purposes patents have in establishing and maintaining relations in business, other than the inherent functions as they are intended by the designers of patent systems (the legal environment to managers) (Kern & Reekum, 2007). Basically, the patent attributed functions in the maturity model are functions dedicated to the exploitation of patents. In table 4 a description of the patent attributed functions can be found. Again, a column is added which contains the most important focus within a particular function.

Patent attributed functions	**Description**	**Focus**
Asset	The patent as a financially valued means of producing gains to the owner.	Financial appreciation of patents.
Performance indicator	The patent considered as an informational medium to represent the company's research performance and technology marketing potential.	Partner portfolio attractiveness. Patent communication.
Portfolio	The patent considered as part of a set of more or less related proprietary technologies that serve the corporate future.	Portfolio composition. Portfolio evaluation. Licensing initiatives. Third party licenses. Company licenses.

Table 4. Overview of attributed functions adapted from Kern and van Reekum (2007)

However, table 4 does not list all of the patent attributed functions. Missing in this case is the liability function. The financial meaning of patent liability is that of securing a loan, for instance when working capital is needed for the company's future operations. The liability variable was dropped by Kern and van Reekum in their original research because respondents did not recognize it enough to give significant answers in their pilot. They left it in their typology to improve on it for future research. In a recent study, a student redeveloped the liability function corresponding with the strategic planning attitudes. Hilarius (2013) looked into and improved on the existing information about the liability function, providing a multidimensional look on the matter. The results of this study can be found in figure 2 below. Consulting with van Reekum resulted in the adaptation of a new approach to liability of which the foundations lie on three concepts: Freedom to Operate (FtO), Liability of Newness (LoN) and financial liability. In figure 1 these three concepts are presented and by using the strategic planning attitude an increasing level of activeness is presented for those concepts. Because no other research has been done in this way to improve on the liability, the typology as presented in figure 1 is adapted and used

in the maturity framework. Given the presentation of the concepts it is possible to translate them to a questionnaire directly.

	Inactive	Reactive	Active	Pro-active
FtO:	When infringement is claimed the activities are stopped and/or the litigation is resolved by settlement.	An FtO is conducted after infringement is claimed to prevent future litigation.	A FtO search is done. When (possible) infringement is found the problem is circumvented or the project canceled.	A FtO search is done. When (possible) infringement is found, circumvention is an option as well as acquiring a license or patent.
LoN:	R&D in new products is avoided. The organizations efforts are aimed at improving and evolving the proven products.	R&D for new products is started when technological rivalry is assessed on the basis of patent info	Alternatives assessed before investing	Initial (R&D) costs are seen as investments, not as costs. The (strategic) development of new products is done according the product life-cycle.
Financial:	Does not use a patent as collateral to obtain a loan.	The patent(portfolio) is valuated, but is not used as collateral	On request of a financier a patent is used to obtain a loan. (exclusively)	The organization uses a patent to obtain a loan. (exclusively)

Figure 2. Liability in the maturity typology (Hilarius, 2013).

In paragraph 2.2 a more elaborate assessment is made on the liability concepts that are discussed here. Looking closer into these concepts will help determine performance indicators, and will therefore not be discussed any further at this point.

2.1.5 Model

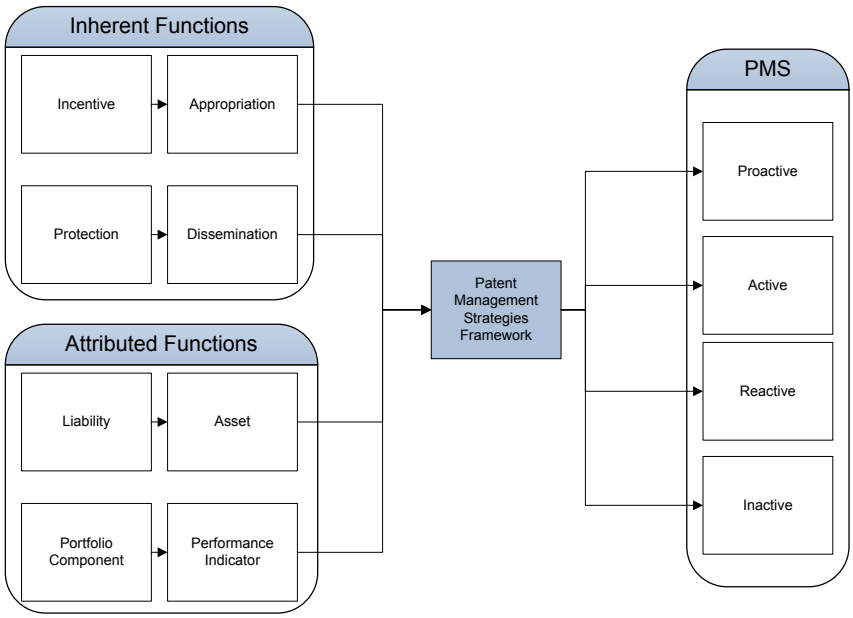

Figure 3. Patent function maturity framework (Perez, 2012)

In figure 3 all the different patent functions and strategic planning attitudes are shown. The most important aspect of the strategic planning attitudes is that they represent an increasing level of activeness (Inactive, Reactive, Active and Proactive). For every function the maturity can be measured with this paradigm.

2.2 Measuring patent function performance

In this section of the paper, patent functions are coupled to performance indicators that are specifically applicable to each function individually. The idea is to establish a link between the maturity of management functions and the actual performance of those functions. In measuring the performance patent management, many companies still have a traditional approach. In this approach, measuring R&D efforts play a significant part. Therefore, in the first part of this paragraph ways to measure R&D efforts are presented. This analysis will present some background on ways that many companies measure performance. In this way you can clearly see the differences with the patent function approach. In the second part of this paragraph the actual indicators for the individual patent functions will be established based on existing theory.

2.2.1 Measuring R&D efforts

Although many models can be found to evaluate R&D such as the Balanced Score Card approach used by Bremser and Barsky (2004), R&D metrics continue to be an important topic for measuring the effectiveness of R&D (Schwartz, Miller, Plummer, & Fusfeld, 2011). Of course one can image that a long list of metrics can be derived when looking at the literature, since R&D metrics continue to progress in their level of sophistication. This has been a pattern observed over the last decade and it's a continually evolving process (Germeraad, 2003). In their first study Swartz et al. (2011) acknowledge that for profit organizations the top three metrics from their survey in 1994—financial return to the business, strategic alignment with the business, and projected value of the R&D pipeline—maintained their importance for profit corporations in their 2009 survey. However, all other metrics from their 1994 survey were consequently substituted in the fore mentioned 2009 study.

In their second study, Swartz et al. (2011) classify top metrics by both using the *Technology Value Pyramid* (TVP) and nature of innovation as is shown in figure 6. The TVP provides a hierarchy of metrics based on the fundamental elements of R&D value and the relationships of those elements to business results in the long and short term (Schwartz, Miller, Plummer, & Fusfeld, 2011, p. 30). The nature of innovation is classified as the Innovation Game (e.g. consumer products) and is set – off against the three levels of the TVP, value creation, strategy and foundation.

What stands out are the outcome favored metrics at the value creation and strategy level of the pyramid. These metrics are relevant because they are in essence indictors to measure the effects of a decision-making process. This shows that although R&D metrics seem to be moving from the quantitative (accountant's viewpoint) to qualitative (CEO's viewpoint) (Germeraad, 2003, p. 54), relative simple outcome metrics are still popular in measuring the effectiveness of R&D. Because R&D management and patent management can be closely related, some of these metrics may be useful in this research.

Innovation Game	TVP Level		
	Value Creation	Strategy	Foundation
New & Improved (Standalone)	Financial Return Projected Value of R&D Pipeline Gross Profit Gross Margin	Financial Return Projected Value of R&D Pipeline Gross Profit Gross Margin	None identified at statistically significant level.
Pushing the Envelope (Integrated Systems)	Financial Return Projected Value of R&D Pipeline Gross Profit Gross Margin	Financial Return Projected Value of R&D Pipeline Gross Profit Gross Margin R&D Investment as % of Sales	People Development Intellectual Property Management Number and Quality of Patents
Consumer Products	Financial Return Product Quality & Reliability Gross Margin Gross Profit Market Share	Financial Return Gross Margin Gross Profit R&D Investment as % of Sales Probability of Success	People Development Intellectual Property Management Number and Quality of Patents
Services	Intellectual Property Management Financial Return	Financial Return	Idea Generation and Creativity R&D Process People Development Quality of Personnel Number and Quality of Patents

Figure 4. Top metrics by innovation game (Schwartz, Miller, Plummer, & Fusfeld, 2011, p. 34).

When searching the literature for the most frequently used R&D metrics is becomes apparent that roughly the same results show up. In a study by the Goldense Group Inc. in 2004 the overall use of metrics in industry was researched. The study was conducted by sending questionnaires to a wide distribution of Product Development professionals in industry in North America, Europe, and Asia. Replies were received from 202 companies, ranging from industrial and medical products to aerospace, defense, electronics, and chemicals industries (Goldense, Schwartz, & James, 2005). In table 1 the most widely used metrics for R&D of that study are summarized.

Top R&D Metrics	
R&D spending as a percent of sales.	Percent of resources/investment dedicated to new product development
Total patents filed/pending/awarded.	Current-year % sales due to new products released in the past N years.
Total R&D head count.	First year profits of new products.
Number of products/projects in active development.	Percentage resources/investment dedicated to sustaining existing products.
First year sales of new products.	Number of products released

Table 5. An adaptation of the Stage-Gate framework for new product development (Goldense, Schwartz, & James, 2005).

Some of the items in table 1 seem to be headed in the direction of this study, for example the total patents filed/pending/awarded metric. Most of these metrics however seem not only difficult to measure in for example a survey study, but are at a very high level making it impossible to couple to patent management activities. In the next sub paragraphs the indicators for the individual patent function are discussed.

2.2.2 Incentive

As mentioned in the description of the incentive function patents can be used to motivate R&D efforts and output. In the previous sub paragraph the measurement of R&D output was discussed. According to Loch and Tapper (2000) it is very difficult to derive the right R&D performance measures. Performance measurement is particularly difficult in the R&D function because the success of a product or process can often only be assessed with certainty after a long delay (Loch & Tapper, 2000). So a simple means for evaluating R&D performance is what is required to asses many companies that potentially differ in technology, size and sector. However, when you take in account such general ways to measure R&D output, it is likely that many of the patent functions will contribute to an indicator based on such broad metrics. Besides this, the goal of this research is to measure the performance of practices that fall under the different functions. The aim of practices that fall under the incentive function is to stimulate employees to contribute to for example patents.

So when you look at how van Kern & van Reekum (2007) describe the incentive function, it becomes clear that there is a clear emphasis on both commercialization of research results that fall outside the company's strategy by employees and explicit rewards for researchers within the company that have (at least some) share in the realization of patents. When you follow this philosophy there are basically two questions that can be distinguished:

- Do employees feel stimulated to support commercialization of research results that fall outside the company's strategy?
- Do researchers contribute to the commercialization of research results that fall outside the company's strategy?

Looking at rewards for employees that take part in the realization it is difficult to measure the actual rewards given out.

In the context of this research it is also important to measure whether researchers are aware of the regulations that are drafted by a company concerning patents (Uitvoeringsregeling octrooien, 2010). Therefore, researchers should be aware of:

- Policy of the company concerning inventions made by employees.
- The compensation structure that is in effect regarding patents that are realized within the company there are active in.

The underlying thought here is that in a company, employees (that have at least some share in the realization of patents) should be aware of both policy concerning inventions and compensation structure. This awareness will most likely contribute to an increase in the R&D effort. A simple performance measure would therefore be to see what percentage of employees is aware of the points mentioned above.

2.2.3 Appropriation

In the context of this study appropriation means that a patent can be a mechanism providing functional exclusiveness to an invention. The idea is that an invention can be commercialized due to the exclusive right a patent provides. In light of this study appropriation can be seen as the part of the inventions a company acquires a patent for. According to Scherer (1983,) the number of patents that a company holds is connected with the level of expenditure of research and development (R&D). Companies that spend little or no money on

R&D also have little patent applications. This in effect means that the probability of patenting increases with the expenses on R&D. This notion implies that it is important to realize the difference between applying for a patent and actually gaining it.

A simple way to measure appropriation would therefore be to look at patent intensity, measured as its number of patents divided by sales (Hitt, Hoskisson, Ireland, & Harrison, 1991). But as described above, with a given innovation intensity, different firms may have a different patenting intensity, implying that patents may be a problematic innovation indicator (Brouwer & Kleinknecht, 1999, p. 615). Scherer (1983) calls this the propensity to patent, suggesting that the number of patents a company applies for varies across firm characteristics and sectors. Patent propensity is defined further as the number of patents per unit of expenditure on R&D (Scherer, 1983). This definition is complex to interpret because it is influenced by the efficiency of R&D, the reasons why firms patent, and other factors such as technological opportunities (Arundel & Kabla, 1998).

Fortunately there are other authors who elaborate on the concept of the propensity to patent. The reason why this concept is further explored here is because it captures the attitude of a company towards patenting. This is important because you would assume that companies with a mature appropriation regime (as described in the context of this study) will not only have a positive attitude towards patent protection, but a high percentage of innovations that are patented as well.

What remains of course is the actual way to calculate the rate organizations patent their innovations. Arundel and Kabla (1998) contributed to this concept and provided means to measure this feature. The exact wording question on patent propensity in their research is: ‘‘in the last three years, a patent application was made for approximately what percentage of your unit’s product and process innovations?’’. When you combine this with the number of patents granted you can measure to some extent what the patent intensity is, but it also says something about how much attention is given to the patentability of research (results).

Apart from measuring the patent application to patent granted, the way contracts, and publications are handled in a company form trivial patent management practices within the appropriation function. According to Arundel and Kabla (1998) the following topics are therefore important when researching results over a particular period:

- Contracts that are made on a company’s exploitation rights on intellectual property.
- Results that are published (articles, presentations, conferences).

Similar to the questions about patent applications and patents granted, these topics lend themselves to be measured on a percentage scale. Investigating the percentage of patent applications on innovations, patents granted, contracts made and results published give a great way to measure the performance of the appropriation function.

2.2.4 Protection

The third patent function is protection. As noted the patent represents the legal ability to exclude others from gaining returns on investments the proprietor made to create the invention. In the article by van Kern & van Reekum (2007) it is mentioned that the mechanisms in place to enforce patents are what determine the protection. Patent effectiveness is in this a term that can be used in this regard. The term patent effectiveness

means “strength of patent protection” (Ashish & Ceccagnoli, 2006, p. 5). A variety of factors may drive the effectiveness of patents, including increases in length or breadth of protection, greater codifiability of knowledge, decreases in costs of application, and costs of disclosure (Horstmann, MacDonald, & Slivinski, 1985). These elaborate formulas miss the translation to the simple set-up of a survey. However, in article by Johnson, Cohen and Junker (1999) the subject surfaces in sample questionnaire questions that are used to measure appropriation (see table 6). These authors build and adapt on the 1994 Carnegie Mellon Survey of Industrial R&D in the U.S. In this survey there are two questions that value the perception of the effectiveness of six mechanisms of protecting product and process innovations. For both process and product innovation the question is “During the last three years for what percent of your innovations was each of the following effective in protecting your firm’s competitive advantage for those innovations?” (Johnson, Cohen, & Junker, 1999).

During the last five years for what percent of your innovations was each of the following effective in protecting your firm’s competitive advantage for those innovations?					
	0-10%	11-40%	41-60%	61-90%	91-100%
Secrecy	1	2	3	4	5
Patent protection	1	2	3	4	5
Other legal mechanisms	1	2	3	4	5
First to market	1	2	3	4	5
Complementary sales/service	1	2	3	4	5
Complementary manufacturing	1	2	3	4	5

Table 6. An adaption of the assessment of protection measures by Johnson, Cohen and Junker (1999).

In their work on Propensity to patent, Brouwer & Kleinknecht (1999) also look how companies judge the effectiveness of different ways to protect product or process innovations. They distinguish seven mechanisms of protection against imitators and companies can value these methods on a scale from insignificant to crucial. What is interesting is that patent protection is valued rather insignificant by almost half of the ‘innovating firms’. So to indicate how effective companies rate patents as a protection of their product innovations against imitators this five-point scale can be used to achieve that goal.

The way Brouwer & Kleinknecht (1999) look how companies judge the effectiveness of different ways to protect product or process innovations seems more comprehensive than the questions raised by Johnson, Cohen and Junker (1999) . Therefore different mechanisms of the appropriation regime should be: Time lead on competitors, keeping qualified people in the firm, secrecy, patent protection, complexity of product or process design, copyright and related laws and certification, normalization. The question raised here should therefore be: “During the last five years, what is your judgment about the effectiveness of various mechanisms for protection of product (or service)/ process innovations against imitators?”. By various mechanisms is meant the mechanisms of the appropriation regime as mentioned above.

When van Reekum further discusses patent protection there are other topics that are highlighted and important for this research. These are licensing, tracking and fighting infringement and litigation. Technology

licenses are contractual agreements that grant organizations permission to use a particular piece of patent-protected knowledge held by another organization (Nelson, 2009, p. 996). Interesting would be therefore to know for which percentage of patents (cross) licensing was used to prevent infringement. Of course, prevention cannot always be guaranteed.

Judgements by innovating firms[a] about the effectiveness of various mechanism for protection of *product (or service) / process* innovations against imitators

Mechanism of protection against imitators	Judgement about effectiveness (percentages)				
	Insignificant	Modest	Moderate	Very important	Crucial
(a) Product (or service)					
Time lead on competitors	20.5 (23.8)[b]	6.1 (6.8)	16.3 (16.3)	37.8 (37.0)	19.4 (16.1)
Keeping qualified people in the firm	17.1 (18.0)	5.5 (5.9)	21.6 (22.2)	39.6 (39.9)	16.1 (14.0)
Secrecy	33.2 (36.6)	13.3 (14.4)	20.8 (21.6)	18.9 (15.5)	13.8 (11.9)
Patent protection	47.0 (50.0)	14.9 (15.0)	12.6 (10.9)	15.1 (15.1)	10.3 (9.0)
Complexity of product or process design	47.6 (52.0)	11.8 (11.8)	19.5 (17.2)	15.1 (13.5)	6.0 (5.5)
Copyright and related laws	61.5 (61.8)	14.6 (14.2)	12.4 (11.2)	8.7 (9.5)	2.8 (3.2)
Certification, normalisation	47.4 (47.8)	16.5 (17.0)	17.6 (17.2)	14.9 (14.0)	3.6 (4.0)
(b) Process					
Time lead on competitors	22.9	6.4	14.8	34.8	21.2
Keeping qualified people in the firm	16.7	3.3	21.7	39.6	18.8
Secrecy	32.4	9.7	16.4	22.7	18.6
Patent protection	55.4	15.6	11.1	11.8	6.2
Complexity of product or process design	45.9	10.0	21.5	15.6	7.0
Copyright and related laws	72.8	13.5	8.2	4.5	1.1
Certification, normalisation	56.8	13.2	14.0	13.9	2.1

Number of observations: 1.008.
Source: CIS-Netherlands, 1992.
[a]Answers by firms which developed or introduced new or improved products, services or processes during the last 3 years.
[b]Figures in brackets cover answers by firms which realised sales of products (or services) *new to the sector* in 1992.

Figure 5. Mechanisms of protection versus effectiveness (Brouwer & Kleinknecht, 1999).

So, if you combine the topics discussed, the following performance indicators can be selected:

- The prevention of litigation (e.g. by sending out a warning or by offering (cross) licenses).
- Positive outcomes of litigation suits.

Combining all this information, only three indicators remain. On one hand the effectiveness of various protection mechanisms is measured. On the other hand the strength of litigation prevention practices and the strength of practices that ensure a positive outcome of litigation suits are measured.

2.2.5 Dissemination

The dissemination function describes the patent as a source of information open to competitors. This source is open to competitors as a consequence of publication. So far, publication of research results is already covered in the appropriation function.

A patent is a source of information open to competitors so you could imagine that you would want to know if competitors use that information. This is not necessarily a bad thing, in fact if competitors are interested in information found in patent held by a company than that information must be valuable. However it can be difficult to assess to what extent another company is using information in for example new patent because you would have to identify corporate rivals and make a narrow and broad assessment of relevance to the focal firm (McGahan & Silverman, 2006). However, you can always ask if information that can be found in patents held by a company is used as a source in R&D by rival companies.

You can also look at the way information from patents or patent databases is used and spread across the company. The experience in searching for patent information can therefore be important. In normal circumstances, experience can be described as what people have dealt with in the past and can apply to practical situations and transfer to others. The experience in this case would be how much patent information is actually used in a particular company. It is important here is to somehow look at the frequency of use so it can be seen if companies that claim to use this information actually do this in a frequent manner. The appropriate topic to investigate would therefore be: "How frequent is information from patents or patent databases used?".

And not only the frequency is important, but also if patent support staff stimulates the use of patent information in technical research. These topics need to be addressed when looking at the dissemination of patent information. In summary:

- Patent information as a source for rival companies.
- The use of Information from patents or patent databases.
- Patent support staff stimulation.

2.2.6 Liability

As described earlier, the liability function can be considered the opposite of the protection function. The protection function of patents allows a company to exclusively commercialize on an invention, while the liability function is there to prevent infringement on patents of other parties. In this section a dependent variable is sought to test whether companies that apply mature management practices actually avoid infringement. In the case of this particular patent management practice it is actually more difficult to do so since the previous mentioned work by Kern and van Reekum (2007) only tackles the liability function on a theoretical level and was not incorporated in the final survey. As described in the maturity framework, the approach to liability relies on three concepts: Freedom to Operate (FtO), Liability of Newness (LoN) and financial liability (see figure 2). In this section these concepts are discussed so performance indicators can be deduced.

Although it is not a relatively new concept, Freedom to Operate has recently received a lot of attention in the field of intellectual property. When trying to prevent infringement on other parties it is important to look into what is usually referred to as prior art. Looking into previous art may require a great deal of preparation and can be a tedious process but it denotes the legal freedom a company has without infringement on intellectual property rights (IPR) of other parties. Sandal and Kumar add: "The result of FTO analysis is expected to ring an alarm bell or a signal to market the product in focus, in [a particular] country" (Sandal & Kumar, 2011). It can be expected that companies with a proactive and active attitude towards the liability function will have mature practices that focus on the prevention of infringement claims by making analyses. The question to ask her would be: In how many cases over the last three years was infringement claimed by other parties? This clearly marks the distinction between companies who are inactive and reactive towards those who are active and pro-active towards FtO as a tool to essentially prevent infringement on other parties.

The Level of Newness is a concept first introduced by Stinchcombe (1965). The author describes the difficulties new companies face in trying to compete with established and often large firms. This concept can also be translated from organizations to inventions. Because of its nature, inventions propose a risk (liability) to the company since it is the question whether an invention can become an innovation, and perhaps equally important, if it can be protected to harvest potential returns (Stinchcombe, 1965). A large portion of that risk lies in the time, effort and R&D expenses that are put in to an invention to get it up to the level where for example patenting can be considered. Companies that are inactive and reactive in their liability patent practices will not spend time and money on R&D activities, only if rivals challenge them on a technology level (Stinchcombe, 1965). Since the level of R&D is already a part of this theoretical framework, this most important performance indicator would be the percentage of inventions made in a company that are put to use (and therefore become innovations). Organizations with a pro-active liability function will regard R&D costs rather as an investment and there is strategic development of new products.

The last concept to discuss here is financial liability, and it is the original view by Kern and van Reekum (2007) on the liability function of patents. They formulate a clear definition: "The financial meaning of patent liability is that of securing a loan, for instance when working capital is needed for the company's future operations" (Kern & Reekum, 2007, pp. 8-9). They further state: "We learned from the pilot study that, at least in The Netherlands, [the use of patents to secure a loan] is not regarded an option. Dutch tax policy prohibits sale & lease-back constructions with patents as securities […]" (Kern & Reekum, 2007, pp. 8-9). Because in other European counties the use of a patent to secure a loan is not prohibited, the financial liability will be taken into account. So, if you combine the topics discussed, the following performance indicators can be selected:

- Infringement claims made on inventions developed in the company.
- Inventions made in a company that are put to use (and therefore become innovations).
- The extent patents are used to acquire a loan.

2.2.7 Asset

The asset function represents patents as a financially valuated means of producing gains to the owner (Reekum, 2007). Though patents are bought and sold, the institutional conditions of valuation and accounting of immaterial assets are more problematic than to their material counterparts. The initial approaches to measuring the value of patents have relied on data on patent renewal. The obligation to pay renewal fees to keep patents 'alive' implies that it is expensive to patent holders to renew patent protection for an additional year (Gambardella, Harhoff, & Verspagen, 2008, p. 69). Another example is the way Reitzig (2004) describes several value definitions of patents that seem possible in general. The value construct they offer for patents consists of the following main determinants: state of the art (of existing technology), novelty, inventive step, breadth, difficulty of inventing around, disclosure, and dependence on complementary assets (Reitzig, 2004, p. 940).

This approach seems thorough but it is incredibly difficult to research such a broad scope of determinants when conducting a survey. According to Gambardella, Harhoff & Verspagen (2008) an extensive European study can be used to get an idea how patent value is determined. In their own work they expand on

this study by connecting patent value to other determinants.Their measure shows significant correlation with the number of patent citations, references, claims, and countries in which the patent is applied.

Citations can be a useful tool but are difficult to determine just by a survey alone. For the survey useful information can be derived from the above mentioned European study. Dubbed 'The PatVal EU Project', this study examines the value of European patents by means of a survey amongst inventors. One of these questions stand out that can be used in the survey conducted in this study: In comparison with other patents in your industry or technological field, how would you rate the economic and strategic value of your patent?

Ways to determine the actual value of patents in a company's portfolio can be done in several ways. According to the website of the United States Patent and Trademark Office (USPTO) there are three basic means to accomplish this goal. It is stated that when another company wants to acquire your patent the value of your patent can be based on:

- The (replacement) cost of the protection right.
- The future cash flows of a patented invention.
- Similar patents or patented products that have been sold in the market.

There are of course many ways that companies financially appreciate their patents. But it is clear that using a clear philosophy in appreciating patents shows a high performance for the asset function. Because every method has a strategic purpose behind it and those companies who have a strong asset function will use each of the methods above in a strategic way. The economic value, strategic value and the use of clear philosophy will be adapted to fit the purpose of this study as can be seen in the final questionnaire.

2.2.8 Performance indicator

Patented technology can be used externally to achieve important operational (e.g. by patent sale) and strategic (e.g. access to technology by cross-licensing or R&D alliances) benefits. The latter aspect has become increasingly important in many industries in which a strong patent portfolio is a requirement for gaining access to important technological know-how from external sources (Ernst, 2003, p. 234). So when you look at patents as a performance indicator it is important to both communicate the patent portfolio of your own company and identify partners based on their respective patents portfolio's developed.

When you look at the identification of potential partners it is evident from prior research that partner selection is an important variable affecting operations. The specific partners chosen can influence the overall mix of available skills and resources, the operating policies and procedures, and the short-and long-term viability (Geringer, 1991, p. 54). One can image that in choosing a partner the patent portfolios of both parties has a high priority.

A table presented in the work of Ernst (2003) provides a conceptual framework for partner selection based on patent information. In the process there is a distinction between whether the motive of the partnership is to access the technology or not. On these two guiding strategies there are three subsections, seen as assessment points in the process that are very useful in this study. In partner selection, the three questions that need to be answered are:

- Is acquiring access to the technology of a partner the main motive?
- Is the identification of options and data retrieval done based on patent information?

- Is the patent portfolio the decisive factor in choosing a partnership?

According to Ernst (2003), the performance in the selection process determines these questions, and to what extent these questions are answered positively.

2.2.9 Portfolio

In the previous section, one of the questions that was raised how well someone from within the company would be able to rate the strategic value of the patent portfolio. In this section however we will look at how the patent portfolio itself is rated. Theories of portfolio management address the question of how a firm can reduce risk and tap into business opportunities by effectively holding a collection of different technologies, markets, or resources (Lin, Chen, & Wu, 2006, p. 17). The key factor here seems to diversity. When we look at the value of patent portfolio in particular it is hard not to account for the connection between the performance of the patent portfolio and firm performance. According to Lin, Chen & Wu (2006), modern finance portfolio theory suggests that investors should diversify their portfolio of financial assets to reduce their risk, so that risk-adverse managers might apply the portfolio theory from the finance literature and therefore argue for unrelated technology diversification.

Stressing the importance of technological diversity basically divides businesses based on technological classification. On the one hand there are high-tech companies that are highly diversified in their technological competencies, and this diversity is increasing over time. Therefore, a firm's long-term value can be improved through increasing diversity in its technology portfolio (Lin, Chen, & Wu, 2006, p. 18). For example, for many smart phone manufactures it is vital that a diversified portfolio exist that encompass the many technologies used in that particular product (e.g. camera, display). On the other hand it can be argued that companies follow the so called 'capability-based' theory. This means that the focus rests on core competences so that for example technological leadership can be achieved in a particular field. An example here would be manufacturers of computer chips who rely on a specific technology. Diversity in this respect refers to the extent to which a company diversifies on a specific technology.

But what does this mean for the value of a patent portfolio? According to Lin, Chen & Wu (2006), there are three basic items that are important in determining a portfolio:

- First, patent claims as they appear in the front page of each patent are the building blocks of patented invention. The average number of patent claims per patent is used as an indicator of the "scope" or "richness" of a firm's patent portfolio.
- Second, self-citations measure the average percentage of patent citations that the assignee cites its own previous patent inventions. This measure reflects the degree to which the inventions in a technology portfolio are unique, independent, and have less knowledge spillover.
- Finally, originality is to measure the extent to which a patent cites previous patents that belong to a wide range of technological fields.

Added to these items are the two distinctions made above about technological diversity. Lin, Chen & Wu (2006) classify these as: Broad Technology Diversity (BTD) and Core Field Diversity (CFD). For all these items models and existing statistics were used to establish correlations between variables. Because in this research a survey is used as the primary method it is necessary to convert the items mentioned above from text to

questions with appropriate scales. Again, in alliance with the other patent functions a five-point Likert scale will be used to facilitate this goal. As an example, the question related to CFD will be: 'How would you grade the degree to which your firm has built a diversified repertoire of technology portfolio in your primary technology category?'.

The other questions and related scales related to the patent portfolio will be discussed in the methodology section and can be found in full in the appendices.

2.3 Controlling for firm characteristics

It can be imagined that particular factors can have influence on the results of this research. The main question is formulated the way it is because it is expected that companies with a pro-active attitude towards patent functions will perform better on those functions. Kern and van Reekum argue: "The Patent Management Maturity Model can be used as an instrument for surveying patent-intensive sectors for policy making purposes (Kern & Reekum, 2007). And they continue stating that: "Differences in the results seem to vary strongly with firm size, age and technology (Kern & Reekum, 2007)". Figure 6 shows the relationships amongst the independent, dependent and moderating variables.

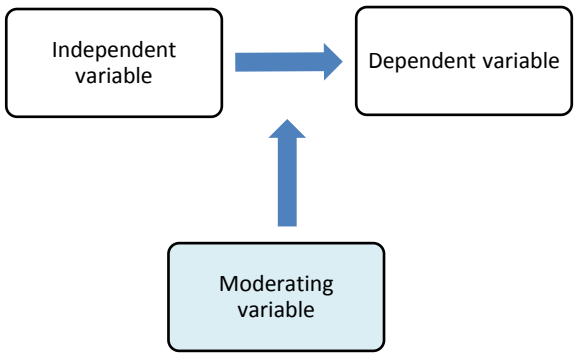

Figure 6. An overview of the relationship amongst the independent, moderating and dependent variables.

According to Kern and van Reekum (2007) firm size, age and technology (sector) differences have the most influence on their typology. The authors argue that smaller firms lack the financial means to create and maintain their patents. Therefore you would expect that larger firms to use patents more actively. Difference in sectors can also be an issue due to specific regulations, entrepreneurial spirit, technological regimes, patent awareness, public R&D, innovation policies, etc. For example, firms operating in patent-intensive industries will most likely score better on the maturity of patent functions. Undoubtedly, these factors will determine outcomes of surveys using this typology crosswise (Kern & Reekum, 2007). That is why size, age and technology will count as control variables as they are likely to affect the relationship between the independent en dependent variable.

2.4 Conceptual model

Given the amount of information provided in the previous paragraphs, this section is used to put the gathered data in a conceptual model for an overview of the situation.

2.4.1 Model

When you construct a model it is important highlight the variables and the expected relationship between those variables. The basis for the model is derived from the theoretical framework; this means that each patent function will have a measure of maturity attached to it. In this study, maturity is measured based on a planning attitude per paten function (e.g. proactive). Subsequently for each patent function the related performance indicators were sought and highlighted. The idea here is that the maturity of each function says something about the performance of that same function. In other words, the more active the attitude towards the patent functions are, the better is scored on the performance of those individual patent functions.
In figure 4, a basic overview is presented of the research model including the control variables. Here you can clearly see the direction of the different variables.

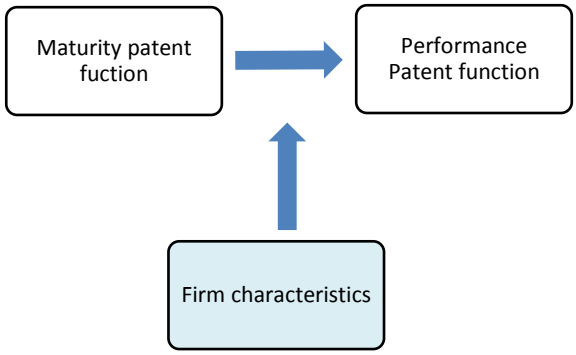

Figure 7. Research overview.

Per patent function the planning attitude is the independent variable. The dependent variable here is the performance of each individual function. As described earlier the premise is that mature patent practices will lead to more active strategic planning attitude per function, and that this will have a positive effect on performance of that function. The flow of these variables could later prove to be interchangeable but since logic suggests that particular outcomes are a result of policy it is left this way for now.

Of course it would have been easy just to look at economic factors, and compare firms based on that. The problem with that approach is that it is very difficult to prove a direct relation exist between the attitude and implementation towards patent management practices and general economic indicators. To provide a step in-between, the performance of eight patent functions is investigated. When the empirical research is completed, hopefully the results will indicate what patent functions are worth investing time and money in to produce significant results for at least the companies involved.

Factors influencing this relationship are the characteristics of a firm, so it can be expected that these characteristics have an influence on the effect. The most important relations of this research can be found in figure 7.

2.5 Operationalization and research model

The concepts described in the previous section have to be operationalized before any attempts can be made to find answers on the proposed hypotheses. The complete questionnaire can be found the appendix. As seen in the conceptual model, it is suggested that a planning attitude towards each of the eight patent functions will have a relation with the corresponding performance indicator for that function. The idea is that a mature patent functions will lead to better performance. Factors that influence this relationship are the firm characteristics. These characteristics are important because they can tell something about the maturity of patent management of a firm. In the following text the variables are mentioned again with clear indicators to support them.

2.5.1 Maturity of patent functions

The independent variable of this research represents the work developed by Kern and van Reekum (2007) on the PMMM. With the aid of a pilot study, a questionnaire was built to measure the patent function maturity of SME's operating in the pharmaceutical industry. This questionnaire will also be used in this study and can be found in the appendices. To align this questionnaire to this research several modifications were made. Some questions were polished according to comments made by the authors for improvement. Furthermore, for the liability function, no questions existed at the time. After consulting van Reekum, these missing questions were formulated and added to the existing questionnaire. Instead of providing an overall verdict, the strategic planning attitude will be applied to each individual patent function, in this way it can be coupled to the performance per function. An overview of the items for maturity can be found in the overview in this paragraph. The finished product can be found in the appendices.

2.5.2 Patent function performance

For the dependent variable, the performance of each of the eight patent functions is scrutinized. For each of these functions indicators from the theory are converted to items. As an example the operationalization of the incentive function can be explained (see paragraph 2.2.2). When we look at the incentive function, it suggests that patents can be used to motivate R&D efforts and output. According to Wood (1992) and the information derived from alliance of three Dutch technical universities there are three indicators that could measure the performance of the incentive function: the level of contribution to patent activities (even if they fall outside the company's strategy), awareness of patent policy and awareness of patent compensation structure. These questions were then converted to questions for the questionnaire, dubbed to items from now on. So, for the incentive function, three items are selected: contribution to commercialization, policy awareness and compensation awareness. Because the respondent is asked to make estimates about a particular part of the workforce is ratio scale is used. A ratio scale can be considered to provide the most reliable and valid results.

It is important to stress that for the performance questionnaire for the most part 5-point scales are used. Due to time restrictions it was not possible to construct a similar answer model for performance as was done for maturity by Kern and van Reekum. The advantage is that most 5-point scales are commonly used in survey research. All of these answer scales are ordinal in nature. It is possible to translate the average score per patent function to an overall 5-point performance measure. Therefore, the performance of each patent function is presented from 'Poor' to 'Excellent'.

2.5.3 Firm characteristics

Characteristics of a firm are considered to be the control variable in this research. The prediction is that firm characteristics have a significant influence on the relationship between the planning attitude towards patent practices and patent practice performance. From the work of Brouwer and Kleinknecht (1999) three indicators are selected that align with this study, namely age, sector and size. Each of these indicators corresponds with one item that will appear in the final questionnaire.

2.5.4 Operationalization tables

In this sub paragraph the operationalization of the variables is presented. Here you can find all the items, scales and references to the literature for the performance of the eight different patent functions. Only the operationalization of the performance variable is presented here, since the questionnaire for maturity was already constructed by Kern and van Reekum. The adaptations made to this questionnaire can be found in the appendix. To keep a clear overview, the result of the operationalization can be found in two tables, for the patent inherent functions and the patent attributed functions.

Performance patent inherent functions

In table 7 the operationalization for the performance of the patent inherent function can be found. These are the incentive, appropriation, protection and disseminations functions. Accept for two items, all the answer models could be formulated in 5-point scales. This makes it easier to compare results and combine items into variables. Only the appropriation function has two numeric scales. The choice for this type of scale was made because the answers are expected to be very low percentage wise.

Function	**Item**	**Scale**	**Reference in literature**
Incentive	Contribution to commercialization	Five point scale (0-100%)	(Wood, 1992)
	Policy awareness	Five point scale (0-100%)	(Uitvoeringsregeling octrooien, 2010)
	Compensation awareness	Five point scale (0-100%)	(Uitvoeringsregeling octrooien, 2010)
Appropriation	Application performance	Five point scale (0-100%)	Arundel and Kabla (1998)
	Patent awarded	Five point scale (0-100%)	Arundel and Kabla (1998)
	Patent contract	Numeric	(Kern & Reekum, 2007)
	Publication results	Numeric	(Kern & Reekum, 2007)

Function	Item	Scale	Reference in literature
Protection	Patent protection	Five point scale (Insignificant-Crucial)	Brouwer & Kleinknecht (1999)
	Litigation prevention	Five point scale (0-100%)	(Nelson, 2009, p. 996)
	Litigation outcome	Five point scale (0-100%)	(Nelson, 2009, p. 996)
Dissemination	Rival R&D source	Five point scale (Never-Very Frequently)	(McGahan & Silverman, 2006, p. 1230)
	Patent database search	Five point scale (Never-Very Frequently)	Nijmanting, (2012)
	Support staff stimulus	Five point scale (Never-Very Frequently)	Nijmanting, (2012)

Table 7. Operationalization patent inherent functions.

Performance patent attributed functions

In table 8 the operationalization for the performance of the patent inherent function can be found. These are the asset, liability, performance indication and portfolio functions.

Function	Item	Scale	Reference in literature
Asset	Economic value	Five point scale (Poor-Excellent)	Gambardella, Harhoff & Verspagen (2008)
	Strategic value	Five point scale (Poor-Excellent)	Gambardella, Harhoff & Verspagen (2008)
	Value philosophy	Five point scale (Never-Always)	USPTO
Liability	Infringement claims	Numeric	(Sandal & Kumar, 2011)
	Innovation rate	Numeric	Stinchcombe (1965)
	Loan acquirement	Five point scale (0-100%)	(Kern & Reekum, 2007)
Performance	Access technology partner	Five point scale (Never-Always)	(Geringer, 1991)
	Partner option assessment	Five point scale (Never-Always)	Ernst (2003)
	Partner selection	Five point scale (Never-Always)	Ernst (2003)
Portfolio	Patent claims	Five point scale (Strongly Disagree-Strongly Agree)	Lin, Chen & Wu (2006)
	Portfolio uniqueness	Five point scale (Strongly Disagree-Strongly Agree)	Lin, Chen & Wu (2006)
	Technical range citations	Five point scale (Strongly Disagree-Strongly Agree)	Lin, Chen & Wu (2006)
	Portfolio diversification	Five point scale (Strongly Disagree-Strongly Agree)	Lin, Chen & Wu (2006)

Table 8: Operationalization patent attributed function functions.

2.5.5 Research model

To summarize all the efforts made in the theoretical framework the research model of this study is presented in figure 8.

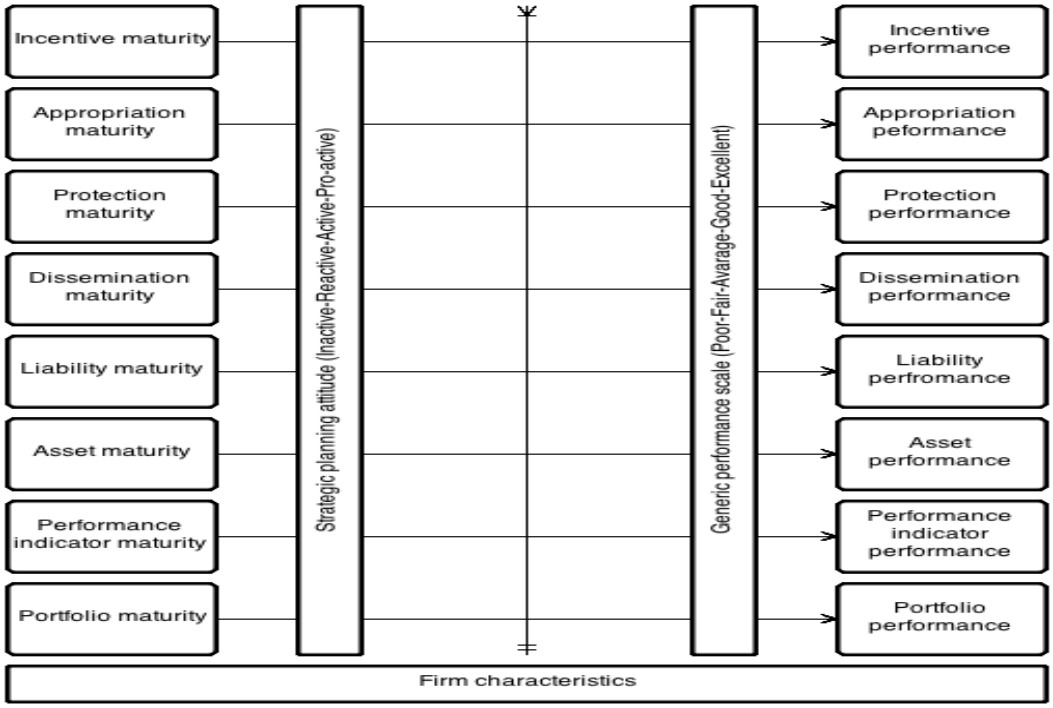

Figure 8. Research model

3. Methodology

In this chapter the research methods of this study are discussed. First, the research design is explained, followed by a description of the target group and sample. After that there will an elaboration on the data collection, and maybe just as important, a discussion about the validity of this research. This chapter will conclude with insights on the data analysis.

3.1 Research design

The objectives and research questions determine for a large part the research design. Looking back at the first chapter there are basically three main objectives:

- Design a model with on the one hand the maturity of eight patent functions (the PMMM) and on the other hand a performance measure based on the same eight different patent functions. The basic assumption is that companies with mature patent functions will also score high on the performance of that function.
- Test the model in an empirical study. The results will at the very least have to say something about the maturity and performance of the target group. Ideally, the results from researching the PMMM and a patent management performance measure can say something about the relationship between each other.
- Because this is a pilot study the results of this study must lead to recommendations on the model and methods used, in this case a questionnaire with corresponding items (see the next paragraph for more details).

Based on these objectives the central question is: 'Do companies with mature patent functions also score higher on the performance of those functions?'. As discussed in the first chapter and in the theoretical framework, it is expected that there is a positive relationship between the independent (maturity) and dependent variable (performance). For a large part these assumptions are fuelled by the results of the original study by Kern and van Reekum. They concluded that for SME's that participated in their study there was a lack of a pro-active attitude for most of the eight patent functions. This resulted in an overall picture of immature patent practices. In this study larger companies are targeted. It expected that these companies therefore have more mature patent practices, and as a result, have a high performance on these practices.

The structure follows an explanatory or confirmatory approach. This is done to give direction to the study and to hopefully translate the structure to future research. In this light variables were constructed from the literature with corresponding hypotheses. There is of course a realistic chance that that correlation cannot be established, but empirical evidence is crucial for making assumptions about the target group, recommendations on the model, methods and for management. The type research design is therefore both descriptive and correlational.

3.1.1 Survey

A good way to get data that can be processes relatively easy is to do survey research (Babbie, 2007). According to Babbie (2007) a research that is done with the help of questionnaires can be used to answer a wide range of

questions, such as the questions that are at the heart of this research. Designing a structured questionnaire seems therefore be the right way. The questions that form the questionnaire are derived from the literature review on patent management performance and the updated questions maturity model developed by Kern and van Reekum (2007). These two questionnaires will be sent to companies simultaneously to investigate the assumptions made in this study. The results will hopefully say something about the patent management practices of the companies involved.

The purpose of a questionnaire is to collect data from individual units in order to describe characteristics, attitudes, and opinions of a given population. The study will focus on closed questions with response scales. For the maturity questionnaire each question except the questions related to the liability function were predetermined in the research of Kern and van Reekum. Each question has four answer options that are unique to that particular question. These answers have an ordinal character, and correspond with one of the planning attitudes designed by Ackoff. So for each question the answers can be arranged from inactive to pro-active, telling us something about the maturity of that practice.

For the performance aspect of this study a literature review was done to find performance measures for each of the eight patent functions. For the feasibility of this study 5-point scales were used that were already proven in theory. Not every question has a 5-point scale however. Some questions were adapted beforehand to ensure better results. For the performance questions the answers also have an ordinal character, and are translated to a uniform performance measurement scale. So for each question the answers are translated to a score ranging from poor to excellent, telling us something about the performance of that practice. For these questions the following points were considered (Babbie, 2007):

- Ensure that questions are clear.
- A question should not have multiple components.
- The question should not be outside the ability of the respondent.
- Respondents should be prepared to answer questions.
- Questions should be relevant in the study.
- Keep the questions short.
- Avoid items that can be considered negative.
- Avoid items that involve bias about terms.

3.1.2 Interviews

Because it is a pilot study, it seems valid to use more than one method for gathering data. After all, the results must also reflect on the theoretical aspects of the study and the methods used. In this regard, interviews can be a good way to dig deeper into the questions of this study. This is a qualitative approach provides another method of data collection. These interviews can improve on the validity of this study. In-depth, face-to-face and open-ended interviews will provide information that cannot be attained by a questionnaire alone.
More importantly, one of the most important research objectives is to comment on the model, but also to make recommendations for improving the questionnaires. Therefore respondent will be asked not to fill in the questionnaires, but comment on the items used and if possible make recommendations for improving them.

3.2 Target group and sample

The target group, or unit of analysis, is the group about which statements are made. This means that the group chosen for this purpose implies a level of generalization. As described in the introduction to this research, large companies that at least involved in a level of patenting and patent practice activities are the main focus here. This focus comes from the notion that in general, the understanding of and the attitude towards the use of patents are in many SME's blurred and are certainly falling behind that of their counterparts from large companies (Kern & Reekum, 2007). Kern and van Reekum (2007) further elaborate by stating that: "Strategic patent management is a critical success factor in patent-intensive businesses". In their original study, Kern and van Reekum (2007) targeted SME's in the Dutch pharmaceutical industry. From an international point of view it is therefore an added value to say something about West-European multinational enterprises (MNE's) with more than 50 employees who are active in patent-intensive businesses, and have some form of strategic patent management practices. Because this is a pilot study the sample will probably not be large enough to make generalizations on that level, but is it left this way to set the bar for future research,

Also, in an ideal situation a distinction would be made in which individuals with different responsibilities would be targeted. You can imagine that individuals with different responsibilities possess different knowledge, and a distinction would then be made which individuals receive which questionnaire for the targeted companies.

Contacting such a large group of companies proved a near impossible task for a study of this magnitude, let alone targeting different patent specialist within that group. Due to company policy it is nearly impossible to contact these people directly. For example, the Dutch patenting agency provided some indication in the companies that filed for a patent in the last 5 years. However, this was not a reliable list, and it would still mean targeting individuals directly. At this point in the research, any data from companies would have been welcome given the difficulties presented above. Luckily an opportunity presented itself when contact was established with a Dutch organization that organizes meetings for patent specialists. This organization, The WON, agreed to distribute the questionnaires amongst their members.

3.2.1 The WON

So struggling with finding a representative sample a suggestion was made by the Dutch patenting agency to contact organizations that act as forums for companies to come in contact with each other and share knowledge on different fields. Multiple of these organizations such as CEPIUG, PIUG, EIRMA, EPO, EPI, and the WON were contacted. From these organizations the Dutch work organization for patent information (WON) responded positively. This organization was established in 1977 with the aim of spreading knowledge on patent information and also to make sure that technical and scientific information is fully accessible and available for those who want to file for a patent. The WON unites the patent information specialists from companies and institutions. They are responsible for ensuring that patent information in their organizations is adequately available and used. Given the struggle with the target population this presented the perfect opportunity to come in contact with large MNE's (WON, 2008).

Won affiliated industrial companies		
Abbott Healthcare Products BV	FujiFilm Manufacturing Europe BV	Philips International BV
Agfa-Graphics NV	Hunter Douglas NV	Picanol NV
Akzo Nobel NV	Huntsman Europe BVBA	Sabic
Albemarle Catalysts BV	IMEC	Shell International BV
ASML Netherlands B.V.	Inalfa Roof Systems Group	Sirris
Assa Abloy	KeyGene	SKF Research and Development
Astellas Pharma Europe BV	Lankhorst Sneek BV	Company
Avantium	Marel stork poultry processing BV 5	Stamicarbon
Avebe Research & Development	Meyn Food Processing Technology BV	Synthon BV
Bejo Zaden	MSD / Merck	Syral Belgium nv
Bekaert NV/SA	MTI Holland BV	Tata Steel
Boult Wade Tennant	Neopost Technologies BV	TBG Europe NV
CNH Belgium NV	Niko Group NV	Top Institute Food and Nutrition
Crucell Holland BV	Nuplex Resins BV	Unilever NV
D.E Master Blenders 1753	Nutreco International BV	Vanderlande
Danone Research	NXP Semiconductors Netherlands BV	Wavin
Dorel B.V.	Oce PPP Intellectual Property	WTCB
DSM	Octrooibureau Van Der Lely NV	Zeepfabriek Dalli de Klok BV
Fokker Aerostructures BV		
FrieslandCampina Innovation Centre		

Table 9. Sample group.

One of the requirements of this organization was to make to questionnaires completely anonymous so that results cannot be converted to individuals or companies. Although it is impossible to see which companies participated, it is possible to show which companies were targeted. In the table below you can see the industrial companies affiliated the WON.

The sample, or unit of observations, is part of the target population. If the sample is a good representation of the target population, the results will say something about the target population as a whole. For this research contacting such a 'large group' can be considered a breakthrough. From a methodological standpoint however this is not a large group. However this group exactly meets the target group criteria. The sample consists of all the companies that filed in the questionnaires, since the all the companies were targeted.

3.3 Data collection

As discussed in this paragraph the choice was made to conduct a survey using questionnaires. Because of the length of both questionnaires and the similarity in structure these were presented separately. To ensure anonymity of respondents and to receive data that could be easy to process an online survey tool was used. The WON secretariat forwarded a request containing two survey links to the target population. Because the

data collection was conducted over the summer the request was sent three times over three weeks to increase the number of respondents. Information regarding the response can be found in the next chapter.
For the interviews the idea was contact expert in the patent management field. These experts would for a part comment on the questionnaires, providing input to adapt these questionnaires before sending them out. However, just as with the survey route is was very difficult to contact the right people and persuade them to participate. Luckily two experts each working for patent intensive MNE's participated. One interview was done over phone, the other face-to-face. Both interviews lasted over 45 minutes and provided valuable insights. Apart from company information only the questionnaires were discussed. In data collection section below (paragraph 3.5) and the analysis (chapter 4) these interviews are further discussed.

3.4 Validity

Validity is a term describing a measure that accurately reflects the concept it is intended to measure (Babbie, 2007, p. 146). There are considered to be 4 types of validity: statistical conclusion, internal, construct and external validity. Per type of validity, different threats can be distinguished that are applicable to this research (Shadish, Cook, & Campbell, 2002). When you look at statistical conclusion validity, two types of threats are important to take into account:

- The first threat can be there is low statistical power. The source of this problem can be a low number of respondents. A serious lack of respondents can make it difficult to discover relationships that exist within the target group. An easy way to increase the statistical power is to select a larger sample.
- A second threat is the heterogeneity of the respondents. Because respondents operate in businesses with different characteristics, questions may be interpreted differently.

Both issues are difficult to address because they are outside the sphere of influence of this study.

Attrition is a threat to internal validity whereby participants of an experiment do not produce results that can be measured. You can imagine that when respondents are not obligated to fill in a question form and have little connection to the subject may skip questions that have no connection to them. Selection is another threat here. Because companies are free to participate to this research, they automatically differ from businesses that are not compelled to participate.

When looking at construct validity, there is the danger of the so called 'mono-method bias'. This threat can occur when the 'treatment' is presented in the same way to all respondents. Because the two questionnaires are the focus of this research, it is important to complement on this method with qualitative input.

One of the aspects of external validity that is very important to this research is the 'interaction of causal relationship with units'. The question here is if causal relations will stand if you move them to other units of analysis

3.5 Data analysis

The research data comes from two sources: the response to both of the digital questionnaires and notes from both of the interviews. The data from the interviews was clear and was meticulously noted and as intended

could be related to the questionnaire questions one-on-one. Unfortunately it was not possible to do these interviews before the questionnaires were distributed (digitally). Therefore, no items were substantially changed or removed to avoid data from different kind of questionnaires. However, because the questionnaires were distributed digitally it was possible to make small adjustments in the spelling and choice of words to make it clearer for the respondents. For example, in an item related to the liability function (see paragraph 2.5.4) the term 'loan' was used. In the interviews it was made clear that only financial loans apply here, and was consequently changed in the corresponding questionnaire. The analysis (see paragraph 4.2) and recommendations (see paragraph 5.3) based on the interviews can be found in the next chapters.

Response from the questionnaires was captured in an 'Excel' file and transferred to SPSS without a problem. In SPSS answer scales were converted to numbers to increase statistical power. After the completion of a comprehensive dataset for both questionnaires analyses were conduction with the functionality of SPSS. A lot of attention was paid to the descriptive results. The following actions were undertaken:

- The company characteristics were checked to see if the response is representative for the entire target population.
- The descriptive results for the maturity variables and the performance variable were established. All this information is highlighted in the next chapter in order to see if there are differences that are noteworthy. In order to compare these differences with general information from the response companies (e.g. the number of employees) cross-tables are used to present these differences.
- To conclude the descriptive part of the research, a comparison is made between the maturity and performance variables. A mean of each variable will give an idea what the score is on maturity and performance.

Using correlation methods will ultimately show whether there is coherence between different individual variables. In correlation it is important that there is a relationship between two variables. If there is a correlation that does not necessarily mean there is a causal relationship, but it is an important condition (Babbie, 2007). The most important step in this process is to check the reliability for each variable first. This will present a great insight in the theoretical and methodological choices made in this study. All the analyses and results can be found in the next chapter.

4. Analysis

In this chapter the results of both the surveys and interviews are presented. First, a response analysis is done. Here the total response of both the quantitative and qualitative results is discussed. Also, for the survey results, the sample is compared to the target population to say something about the representativeness of the results. The second paragraph will be dedicated to the results of the interviews conducted with two of the leading experts on IP management in The Netherlands. After this the results of the survey presented, starting with the descriptive results for both the maturity and performance concepts, followed by a reliability test for the different variables. Any of the variables that prove to be reliable, are compared, and tested for correlation and regression.

4.1 Response and representativeness

In the previous chapter an overview of the sample was presented. This population consists of 55 companies that were targeted by the aforementioned Dutch work community for patent information specialists. This organization unites the patent information specialists from companies and institutions. They are responsible for ensuring that patent information in their organizations adequately is available and used. For this survey only the companies related to this organization were targeted directly by its secretariat. Of all these companies that were addressed, 20 filled in the questionnaire about the maturity concept, and 17 filled in the performance questionnaire. This translates into a response rate for maturity of 36%, and 31% for performance. Considering the difficulty to address patent specialist in multinational companies these rates can be considered to be high.

The problem is of course the small sample. In the methodology section it is made clear why it was so difficult to target a larger sample, mostly due to company policy and time restrictions. This means that generalizing outside the sample is difficult, even though a fair amount of large multinationals participated. Because of the small target and sample there is low statistical power, which in term makes it difficult to find correlations between different variables. It could even mean that some variables have distorted reliability scores because of the small sample. Due to the high response rates however it is possible to say something about the entire sample itself, which, as discussed, contains some of the largest multinationals in the world and can therefore produce some noteworthy results.

Before we look at the results it is important to consider the characteristics of the respondents to and why certain people have not responded. In this study the firm characteristics are important because they can control for the different results on each variable. For example, one might expect that bigger companies score higher on maturity. Because there has been chosen to bring the individual factors as variables in the study, the results of the individual characteristics of the respondents can be found in the following section. Remarkable is the great diversity in the respondents as is shown in the sample table below. As shown in the table about the sector differences there are 13 sectors represented in the sample. This means that 65% of the respondent companies have a different core business. Because of the great diversity in possible businesses the respondent were ask to fill in their core business themselves.

Sectors	
Intellectual property investment fund	Food ingredient supplier
Steel wire and cord	Life sciences
Maritime industry	Pharmaceuticals
Metals	Agribusiness
Chemistry	Electronic goods
Licensing	Semiconductor
Oil and gas	

Table 10. Sectors represented in sample.

Although this gives a great overview, it is hard to compare with the target population due to the great diversity in business multinationals often have.

It is perfectly possible however to compare the number of employees of the response group with that of the sample. In the way a sense of the representativeness of the response group can be achieved.

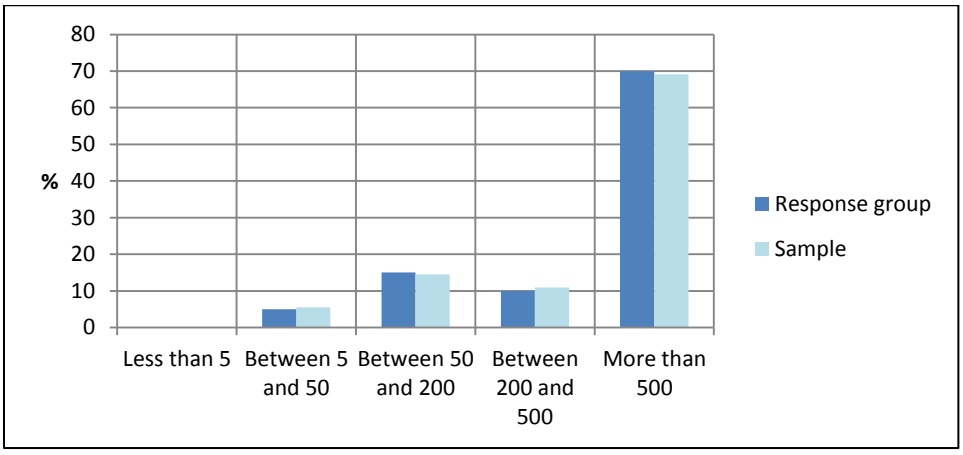

Figure 9. Comparison of Innovation rates for response group and sample.

Looking at numbers in the figure it is remarkable how much the sample and response group are alike in composition. The representativeness of the response can therefore be considered to be very high. If you look at the numbers of employees alone, the companies the sample and response groups seem very much alike given that the percentages for different employee groups match. This will probably mean that statement made about the sample also apply for the target population.

Of course, a survey is not the only method of gathering data in this study. In the next paragraph the most significant results of the interviews that were conducted for this study will be presented first, followed by the survey results.

4.2 Interview results

Because this is a pilot study it is important to use more than one method to gather data. For this purpose, two interviews were conducted with patent specialist working for two patent intensive multinational companies. The aim of these interviews is to gather expert opinions on the questionnaires so they can be improved for

future research. The full interviews can be found in the appendices, but below you can find a summary of the most significant results. Due to privacy considerations it is not possible to name these companies in this document.

4.2.1 Multinational 1

This interview was conducted by telephone with the director of intellectual property. This interview lasted about 45 minutes in which the content of both questionnaires was reviewed. It is important to mention that only the questionnaires were discussed, due to time restrictions it was not possible to review the theoretical part of this research. To be more specific, it was only possible to learn recommendations concerning the questions in the questionnaire. Below the recommendations for each questionnaire are discussed. These recommendations provide useful information for adaption the questionnaires for future research.

Maturity

About the incentive function the interviewee stated that in large corporations it is impossible for employees to commercialize research results that fall outside the strategy of the company due to restrictions in their contracts. This is similar to universities where all (intellectual) exploits of employees belong to the employer. In large companies with extensive intellectual property departments the commercialization of research results only takes place in accordance with strategy and core business. The individual contract of employees defines what is to be done with contributions by employees to intellectual property. Rewards for employees can be found for the most part in the inventive scheme. In this scheme the rewards for contributing in the realization of for example patents are described.

In one the question related to the appropriation function the term ‘contracts’ is used. It should be more specific what is meant by this. For instance, there are sales and work related contracts. Furthermore, the answer to the question whether IP is embedded in contracts is always yes, due to the nature of the process. The only question is when there is collaboration with a third party in developing intellectual property the results of the endeavor is set. Furthermore, in larger companies there is clearance required for publishing research results. Therefore the answer to this question for larger companies would always be ‘yes’.

In the protection function the concept of litigation comes into play. According to the interviewee the consideration to pursue litigation is based on a cost/benefit analysis. Three considerations can be taken into account:

- If the other party should stop, will it actually have any effect?
- Is there a chance to gain compensation for the damages caused?
- Is there significant damage to reputation?

For the dissemination function the use of a database could be explored more deeply. The dissemination of patent information can be done through some form of a database. There are several ways to access a database:

- Internally;
- Via subscription;
- Or via questions to patent attorneys or patent specialists.

A second way is through an invention that becomes a patent. When this happens there can be contact (e.g. through telephone) about the content of this patent. It was noted that under normal circumstances there is a lot of communications concerning patents. This occurs:

- During the whole process of new patent acquisition
- Through the patent portfolio
- To third parties via annual reports and publications

Performance

In the protection function there is a question about the effectiveness of various mechanisms for protection against imitators. It would be better to ask about the effectiveness of protection against infringement. In this way, the question is clearer for respondents. Furthermore check what is meant by certification/normalization, it is not clear what this term adds to the questionnaire.

For the liability function there are several questions that ask a percentage from the respondent. Given the probable low volume answers the percentage could be changed to the number of claims.

For the portfolio function it is suggested here that the number of claims does not have to be that relevant. The power of each claim is more important here. It was not suggested how this 'power' could specifically be measured. Furthermore the term 'high' is used. To respondents this could be considered to be a too subjective measure. Maybe it can be replaced by a term that specifies to a greater extent what is meant by the question.

One of the comments related to both questionnaires is that some questions might be more suited for medium sized companies who not have a complete understanding of their patent management system. For larger companies the patent functions are usually more elaborated and complex.

4.2.2 Multinational 2

This interview was conducted face-to-face in the IP&S department of the company. This interview lasted about an hour and forty-five minutes in which the content of the questionnaire about performance of patent management was reviewed. It is important to mention for a large portion of the interview only the 'performance' questionnaire was discussed, due to time constrictions. Only minor theoretical implications were discussed.

It is important to note that the interviewee stressed the enormous size of the company's R&D. Currently there are working more than 1.500 employees in the research field. Over a typical year, for more than 1.500 inventions a patent application is filed, resulting in more than one patent per scientist per year filed. The patent portfolio constitutes of over 54.000 patents, of which about 15.000 patents are the result of own inventions.

The respondent stressed the importance of this information to fully appreciate the scale of the company's R&D efforts, and important in this study, the management of patents. The company has such a large patent portfolio that it is difficult to measure for example the contribution of employees to one specific topic. This is reflected in the comments on the performance questionnaire that is discussed below.

Performance

For the incentive function scale issues come into play. The company has such a large number of people involved in R&D that is it difficult to relate this question to specific percentages. Also because researchers typically do not move further with the project they are involved in. For project were this is the case it would be possible to measure the percentage involved in commercialization. But as a whole it is difficult to put a label on it. It is important to stress that before innovations become main stream and licensing programs are set up often 5-10 years go by. Making it even more difficult to link employees to the commercialization of research results. Furthermore, there is hardly any financial incentive for employees that are involved in the realization of patents. Within the company it viewed that contribution to patents is just part of the job description. People just get paid based on how well they perform at their job. Salaries are high enough, but there is a small compensation for those who help realize patents.

For the appropriation function a lot of innovations are in the manufacturing process. A lot of these innovations do not lead to patents. That being said, when the decision is made to patent, an application is always filed. A lot of careful consideration is placed in the patent application. This means that a patent application is always almost granted when an application is made. On the subject of licensing, be aware that there is a lot of diversity in licensing contracts. The type of contract depends on the business model. Example: In the bio-pharmaceutical industry there are a lot of start-ups that include licensing in their business model. The company also had different models for licensing. But note that exclusiveness can also be a goal for a company; in this respect performance does not lie in the licensing contracts. Furthermore, licensing can also be a result of coercion from the law, or cooperation to form cross-licenses (e.g. medical semi-conductor industry).

In the protection function there are practices related to litigation. To know how many cases are prevented would take a lot of research to determine this for such a large company. Sometimes it is knowingly ignored. Large players in the market often know their costumers and have a cease-fire with their competitors because of the large stakes and great costs involved with litigation. Larger companies will only engage litigation when the outcome is almost certain in favor of the company. This does not however mean that the cases are always won, but because careful consideration is put in the decision to litigate it is most likely that the percentage of this question is answered high.

On financial appreciation the interviewee states that due to new legislation you cannot put own inventions on the balance sheet.

For the liability function asking about the number of infringement claims can be considered to be confidential information. The question about which percentage of patents is used to acquire a loan is difficult to answer for large companies. There are however some follow-up questions here that could potentially be very interesting. The first could be: “Is the IP portfolio used as collateral for a financial loan?”. The second could be: “Is the IP portfolio used as collateral for attracting investors (capital)?”.

Finally, for the portfolio function it is important to note here is that there are different claim categories. Furthermore there are preconditions to a patent application (number of pages etc.) Also some types of claims have to be in the application, and there is a limitation to the number of claims. If you exceed this limited extra fees have to be paid. So companies will have the maximum claims without paying extra costs.

You can use citations check how early you are in a technological field. If there are a lot of citations then you are probably very late. If you a late in the market It can be very difficult to improve.

After the interview three topics were discussed that could be worthwhile for future research and that connect with this research. These are:

- An important question that could be relevant is: “How is IP bedded in the organization?”. The main focus then would be to identify who is responsible for IP management in the organization. So are there individuals, groups, departments actively involved in IP management. The term ‘actively’ is important here since many organizations have people appointed for IP management but these people at not actively involved. Other questions related to this topic could be: “How many employees work in R&D?” and “What is the size and composition of the IP portfolio?”.
- Check what the financial structure is relating to IP. Companies have different business models with different financial appreciation. One of the questions in the survey related to the appreciation of patents, it would be interesting how firms actually appreciate patents.
- An important recommendation for future research would be to check the company wide entanglement of IP management. Patents are important, but they have important connections with other forms of IP such as brand rights. Example: The patent for aspirin expired years ago, but, through a strong brand name companies can still be ahead of competitors.

So what to do with all the information from the interviews? How did it change the process/outcomes of this research? As mentioned in the methodological section (see paragraph 3.2.1) it was not possible for these results to change the process. Although, it was possible to make minor changes to both questionnaires in terms of word choice and construction of questions and answer scales. However, these results do have an effect on the outcomes of the research. The results show how the questionnaires should be improved in the future to better assess the performance and maturity of patent management in large multinational companies. These improvements will be translated into recommendation in the next chapter.

4.3 Descriptive results

This section will give a closer look at how the questionnaire was completed by respondents. For an explorative study, these results are very important regardless of the correlation and regression problem. Each item gives some insight into the working of patent management practices within large companies. Both for theoretical and managerial implications each of the items that form a variable can hold valuable information. For example, in the performance questionnaire there are questions to measure the performance of the incentive function within a company. Although the question regarding the awareness of financial compensation structure may not be internally consistent with the other items of that variable, the awareness of the compensation structure says something about the performance of the company regarding the incentive function.

In the following paragraph descriptive results of both questionnaires are discussed. For both questionnaires this means that all eight variables are taken into account. For these variables the results are cast into a clear overview.

Due to the large number of items for both questionnaires not every item discussed in depth. Of course an effort is made to present as much relevant information as possible. After the items for maturity and performance are discussed in their own chapters respectively, both datasets are compared on a descriptive level. Of course, all the descriptive results can be found in the appendices.

4.3.1 Maturity

With 36%, the response rate for maturity is the higher of the two. Although not every question was answered, every respondent each at least completed the questionnaire implicating that unanswered questions were deliberately skipped. This can of course be contributed to many factors. The comments left by respondents will hopefully shine some light on this topic. This will be discussed at the very end of this sub paragraph, but will also be referred to in the individual patent functions when implied.

This leaves us for now with the results per variable. In the last two chapters the term maturity is frequently used. It is important to stress that the level of maturity is indicated by the four strategic planning attitudes (inactive, reactive, active and pro-active) as described in the theoretical framework. Almost all questions in the maturity questionnaire have four answer possibilities that relate to the strategic planning attitude by Ackoff. Instead of mentioning the answer scales per item again, a table is presented per variable that include the appropriate items and corresponding planning attitude. For example, the first item of the incentive variable of the maturity questionnaire is: “What is the position of your company regarding employees who independently commercialize research results that fall outside the company's strategy?” of which the first answer scale is: “Dismissive”. This corresponds with an ‘inactive’ strategic planning attitude that together with the other items gives an indication of the maturity of that patent function.

Incentive

The majority of the companies show a reactive attitude towards the commercialization of results that fall outside the company strategy. This means that it is not stimulated and the initiative lies with the employee. If you look at employee rewards the image is a bit distorted, most companies fall in the inactive or active attitude, although the majority has an inactive attitude when it comes to the implementation of a reward mechanism. Overall, the incentive function lies in the inactive-reactive domain.

	Inactive	**Reactive**	**Active**	**Pro-active**
Commercialization of results	27,8%	66,7%	5,6%	0%
Employee rewards	45%	5%	35%	15%

Table 11. Incentive maturity.

Appropriation

There are six items that represent the appropriation function. On three of these of these items the majority of the companies score a pro-active attitude. The overall picture in not entirely clear because the response on the other items show a different outcome.

	Inactive	Reactive	Active	Pro-active
Patent initiative	0%	0%	35%	65%
Regular patent meetings	15%	0%	10%	75%
Patentability of research proposals	10%	55%	30%	5%
IP defined in contracts	15%	10%	40%	35%
Secrecy regulation	0%	25%	50%	25%
Publication regulation	5,3%	31,6%	15,8%	47,4%

Table 12. Appropriation maturity.

It is clear however that for most of the companies the initiative to patent R&D results lies with a patent attorney and/or managers and/or researchers (pro-active). This decreases the chance that appropriation fails. The same pro-active attitude can be found with the regularity that patenting is discussed in work meetings.

This means that in meetings 75% of the sample companies have patenting as a standard on the agenda. Only 15% show that patenting technological knowledge is not part of regular work meetings. The third item was designed to measure whether the patentability of research results is a mandatory part of research proposals. You can see that 30% of the firms this is mandatory (active) and only for 5% this is mandatory including a preview on commercialization.

When you look at the extent that organizations define exploitation rights on IP contracts you see that one third of the organizations define contracts in this way, and more importantly consult with stakeholders/experts. 35 % of the organizations even check in addition to the previous the compliance with contractual agreements (pro-active).

When it comes to secrecy, there are no companies that have no rules and nobody to supervise the secrecy of research results. Here half of the companies define these regulations in labor contracts e.g. in the form of non-disclosure forms that count for internal as external capacity (active). Only in 25% of the companies are employees actually aware of these rules.

The last item covers regulations of research results. The majority of companies have a pro-active attitude towards these regulations, which means that a manager is formally responsible for supervision and employees are informed of the regulations. Still, roughly 30% make agreements on a case by case basis (reactive). Apart from the patentability of research proposals, the response on the appropriation function is oriented towards active-proactive.

Protection

To better understand the results listed in the table 14. It is important to note that of all the companies involved 50% has made an infringement on a patent of a third party.

	Inactive	Reactive	Active	Pro-active
Infringement prevention	0%	10,5%	47,4%	42,1%
Fighting infringement	15%	5%	20%	60%
Litigation decision	11,1%	22.2%	33,3%	33,3%

Table 13. Protection maturity.

Even 75% of the companies report that there has been a situation where a third party has made an infringement on a patent of the company. This will (hopefully) put the results into perspective.

With high scores on infringement suffered it is no surprise that the majority of the companies score an active or pro-active attitude towards the items of the protection function. It shows that most of the companies try to prevent and fight infringement.

When it comes to preventing infringement 47,1% follows potential warnings from competitors and sends out warnings themselves (active). There are no companies that do nothing to prevent infringement as to be expected. Fighting infringement shows even more distinctive choice of attitude as 12 of 20 companies conduct it by internal capacity, whereby external expertise can be acquired for special cases. This means that most of the companies have made an effort to decrease the vulnerability of third party infringement. Only three companies indicate that there are no regulations concerning fighting infringement.

The response to the decision to pursue litigation is a bit more varied, although two-third of the respondents has an active or pro-active attitude towards the litigation problem. Overall you can say that there is a pro-active attitude towards the protection function of patents.

Dissemination

The dissemination function focuses on the use of patent information and the dissemination of patent information. It is clear that for this function the planning attitude is pro-active. This means in most company's patent information is used:

- For patent applications,
- As input for ideas and/or own specific research,
- To gain insight in the strategy of competitors.

	Inactive	Reactive	Active	Pro-active
Patent information usage	0%	0%	15%	85%
Patent information dissemination	0%	20%	25%	65%

Table 14. Dissemination maturity.

It is strange that both the inactive and reactive attitudes received no response at all. This could indicate that the answer scales corresponding with these attitudes do not cover the question enough. This can be checked

by constructing different answer models or leaving room to provide an individual answer. In line with the attitude towards the use of patent information is the pro-active mindset towards patent information dissemination. If you make regular use of patent information it makes sense that this information is structurally provided, which is the case for 65% of the respondents.

Asset

The most significant result here is that almost 60% does not financially appreciate their patents. No less than 11 companies display an inactive attitude towards financial appreciation. Five companies (26,3%) value patents for external accounting based on costs and for internal reports based on expected return or market potential. This variable shows for most companies an inactive attitude. You would expect that large companies would indeed financially appreciate their patents. An explanation could be that large companies operating in very particular sectors do not feel to need to appreciate patents specifically.

	Inactive	**Reactive**	**Active**	**Pro-active**
Patent financial appreciation	57,9%	5,3%	10,5%	26,3%

Table 15. Asset maturity.

Liability

The liability variable was dropped by Kern and van Reekum in their original research because respondents did not recognize it enough to give significant answers in their pilot. As explained in the theoretical section there has been several attempts to translate the theoretical concept of liability to a questionnaire again. One of the most advanced attempts has been translated to this study.

	Inactive	**Reactive**	**Active**	**Pro-active**
Freedom to operate	0%	5,3%	5,3%	89,5%
Technology development effort	5%	0%	5%	90%
Patent loan collateral	65%	25%	5%	5%

Table 16. Liability maturity.

On the items 'freedom to operate' and 'technology development effort' there can be no mistake that there is a pro-active attitude. This means that:

- In facing infringement claims, 89,5% of the companies do an analysis. When possible infringement is found, circumvention is an option, as well as acquiring a license or patent.
- 90% of the companies spend a great deal of effort in technology development. Initial costs are seen as investments, not costs. The development of new products is done according to the product life-cycle paradigm.

This last item of this variable, 'patent loan collateral', displays an inactive attitude towards it. This would mean that most companies do not use patents as collateral for a financial loan. In one of the interviews it was mentioned that this does not happen anymore that often. This is reflected in the recommendations (see chapter 5).

Performance indication

For the performance indication function of patent there are two items namely to what extent portfolios are used to evaluate the attractiveness of potential partners and the level of communication by the company regarding patents. Remarkably enough, the majority of the answers on the first item in concentrated in the reactive attitude while the items on the second item are concentrated in the pro-active attitude.

If you take an even closer look, it seems that between no communication (inactive) and internal communication (pro-active) there is little response. It could be that the 'only external communication' answers (the reactive and active attitudes) are less relevant. The reason this assumption is made is because both in the interviews and in the survey results there were comments regarding this topic. It was stated that for larger companies reporting figures is mandatory. This could explain the difference in response. These results can be found in the table below.

	Inactive	**Reactive**	**Active**	**Pro-active**
Partner attractiveness	21,1%	42,1%	31,6%	5,3%
Patent communication	36,8%	0%	5,3%	57,9%

Table 17. Performance indicator maturity.

Portfolio

There are five items that represent the portfolio function. On only one these of these items the majority of the companies score a pro-active attitude. The overall picture in not entirely clear because the response on the other items show a different outcome. On item level you can see that the majority of response:

- If there is a technological connection as well as a commercial connection the size and composition of the existing patent portfolio is taken into account.
- Patents are evaluated based on financial potential/return and strategic importance.
- The initiative for licensing comes from third parties and management.
- Less than 5 licenses were granted by third companies over the last 5 years.
- Less than 5 licenses were granted by the company over the last 5 years.

The low scores on licenses granted can most likely be explained by information gathered in the in the interviews, since it became clear that the time between a granted patent and licensing activities is (for larger companies) longer than 5 years. In this regard the questions could be formulated differently.

	Inactive	Reactive	Active	Pro-active
Portfolio composition	35%	20%	40%	5%
Portfolio evaluation	5%	15%	5%	75%
Licensing initiative	11,1%	5,5%	55,6%	27,8%
Third party licenses	21,1%	57,9%	15,8%	5,2%
Company licenses	31.6%	31,6%	15,8%	21,1%

Table 18. Portfolio maturity.

Comments

Below are listed the most important comments from respondents that can possibly help build a better questionnaire in the future:

- The list of possible answers for a question is not always complete. There are questions where the answer was not available (no suggestions were made to support this statement).
- Some questions go beyond responsibilities. Questions answered as far as company's policy is.
- Policies may vary per business within the company, so often there is not one right answer, but multiple could apply.
- Rewards are fixed in countries where this is regulated by law (like Germany).
- Results are generally not published.

4.3.2 Performance

With 31%, the response rate for performance is the lower of the two. In accordance with the maturity questionnaire, not every question was answered, but every respondent each at least completed the questionnaire implicating that unanswered questions were deliberately skipped. The comments left by will also be discussed at the very end of this sub paragraph, and will be referred to in the individual patent functions when specifically mentioned.

This leaves again with the results per variable. As described in the theoretical framework (almost) each item is measured based on a 5-point (Likert) scale. This choice was made to create uniformity for measuring purposes and to stay as close as possible to the 4-point scales used in describing the level of maturity. It would have been ideal to construct 4-point scales specifically to measure the level performance just as was done in the maturity model. However time restrictions made it easier to use existing scales. Speaking of which, the performance questionnaire consists mostly of answer scales that refer to an ordinal range of percentage (e.g. 0-20% to 81-100%) to an ordinal range of pre-existing Liker scales (e.g. Strongly Disagree to Strongly Agree). Because each ascending answer of all these types of scale imply a better performance, it seems fitting to label all of the answers according to a general way of presenting performance measure in the same way this was done for the maturity model. This will create a better overview of all the different functions (variables), and will make it easier to compare the results to the results of the maturity questionnaire. Therefore, all of the answers are translated to a scale ranging from ‘Poor’ to ‘Excellent’. In this way, you can immediately gage the performance of a patent function.

So, for each function the average of all the items is calculated. Because all the items are based on 5-point Likert scales the answer is always between 1 and 5. Now you can translate this number to a performance scale to better illustrate the results.

Incentive

When you look at the results of the incentive function a contradiction comes to mind. Although employees seem to know what steps to take when an invention is made, and what compensation there is regarding patenting in the organization, the score on the contribution to commercialization is poor. 50% of the companies indicate that less than 20% of the employees involved in patenting contribute to commercialization. This could indicate that the contribution to commercialization is not effected some much by, for example, financial compensation. This idea is supported in one of the interviews were it was mentioned that in a large enterprise, it is considered that employees are expected to do their job, and that they receive the appropriate financial gains for the work they do.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Contribution to commercialization	50%	18,8%	6,3%	18,8%	6,3%
Policy awareness	11,8%	5,9%	11,8%	17,6%	52,9%
Compensation awareness	17,6%	0%	5,9%	23,5%	52,9%

Table 19. Incentive performance.

Appropriation

For this function there are two open-ended questions that ask a specific percentage of the respondent. Of all the companies involved 43,8% responded that in the last 5 years 0% of the company's patents resulted in licensing contracts. This seems like a rather low figure is you look at the high scores of the maturity questionnaire. However, in the interviews it became clear that the time between a granted patent and licensing activities is (for larger companies) longer than 5 years. Perhaps the question could better be: "How many licensing contract were granted in the last 5 years?".

On the question what percentage of the research results get published, 93,3% of the companies score under the 50%. One of the respondents argued that results generally do not get published, which can explain the low figure.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Application performance	11,8%	11,8%	41,2%	11,8%	23,5%
Patents awarded	6,3%	0%	12,5%	50%	31,3%

Table 20. Appropriation performance.

If you look at the score for patent applications filed for the organizations product and process innovations you see that 41,2% of the companies display a percentage of 41-60%, which corresponds with average on the performance scale. Amazingly enough there are 4 companies that score between 81-100% (excellent). If you look at the high scores on patents awarded, you can't help to conclude that if an application is done, a patent is almost always granted. This indicates the strength of the patent applications, and basically, the strength of the product and process innovations.

Protection

With two excellent scores, and one good, the performance of the protection function seems high. 62,5% of the companies argue that their patent protection is very effective. Half of the companies even state that when infringement was identified, in 81-100% of the cases litigation was successfully prevented.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Patent protection	0%	12,5%	12,5%	62,5%	12,5%
Litigation prevention	14,3%	14,3%	7,1%	14,3%	50%
Litigation outcome	0%	0%	18,2%	18,2%	63,3%

Table 21. Protection performance.

When litigation could not be prevented, 11 companies stress that in 81-100% of the cases the outcome as in favor of the company. As can been seen in the table, there are no scores on poor and average, this could indicate problems with the answer scales. This corresponds with the comments in the interviews that most companies will only pursue litigation when they have made a strong case, and expect the outcome to be favorable. Although you would expect that even for larger companies, the outcome is not always set in stone. Therefore it could also be a result due to the low number of respondents.

Dissemination

The results for this particular function are a bit hard to read. For the items 'rival uses company patent information' and 'employee patent database search, the scores are average. Because of this, it is possible that respondents did not have enough information to answer these questions.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Rival R&D source	6,7%	0%	53,3%	33,3%	6,7%
Patent database search	0%	17,6%	47,1%	29,4%	5,9%
Support staff stimulation	0%	0%	5,9%	64,7%	29,4%

Table 22. Dissemination performance.

This again is reflected in the interviews. If it is true that the employees in most of the companies only use patent information occasionally, it is remarkable that the support from the patent staff is good. This could indicate that the awareness and the use of patent information in technical result are still low.

Asset

It is interesting to see that for the financial appreciation function, often referred to as the asset function; there is a difference in the way companies rate the economic and strategic value of their patents. For the economic value the most scored is 'good', while for strategic value the most scored is 'average'. It would seem that companies score their economic value higher than the strategic value. Still, for bot items near 20% of the companies perform excellent in this regard.

The score and whether the value of a patent is calculated based on a clear and similar philosophy on a frequent basis is average. The low scores on this frequency indicates the diversity in the financial appreciation of patent, or at least that the respondent is not ware how this process takes place in the organization.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Economic patent value	5,9%	0%	17,6%	52,9%	23,5%
Strategic patent value	5,9%	0%	41,2%	35,3%	17,6%
Value philosophy	18,8%	6,3%	62,5%	12,5%	0%

Table 23. Asset performance.

Liability

For this function there are two open-ended questions that ask a specific percentage of the respondent. On the question what the percentage is of infringement claims made on patents developed by the company all the respondents have answered below 20%. On the question what the ratio is of inventions that become innovations the score can be found in the figure below. The figure shows all the percentages the respondents filled in by themselves. It is remarkable that there are such high percentages for the innovation rate. It suggests that for about 75% of the companies, 70% of the inventions become innovations. This says a great deal about the performance of the liability function of those companies.

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Loan securitization	93,8%	0%	0%	0%	6,3%

Table 24. Liability performance.

Looking at the corresponding table, nearly all companies have indicated not to use patents to secure a loan. Apparently this is not a good item for measuring the performance of liability, since only one company responded positively on it.

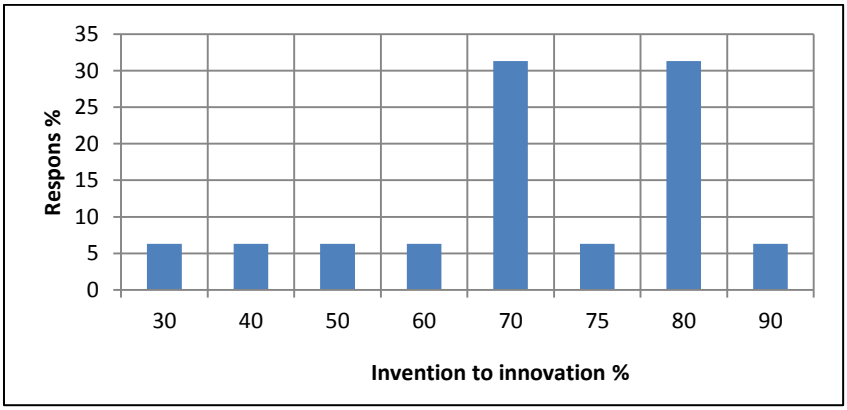

Figure 10. Invention to innovation rate.

Performance indication

Again a function with response that is difficult to interpret. Although in partner selection the access to technology is often the main motive, the score on option assessment en selection of potential partners can be considered to be average to poor. So although in searching for a potential partner the technology of that partner is crucial, however, the option assessment and selection is hardly based on patent information. Even more so, there isn't any response that qualifies for good and excellent performance scores, since not one company indicated to frequently use the patent portfolio in partner selection. This is strange, given that you would expect that especially the larger companies would place a lot of value on the portfolios of potential partners. Not in all high-technology, but certainly in the life sciences, patent portfolio decision making is pivotal to corporate as well as business level management (Kern & Reekum, 2007).

	Poor	**Fair**	**Average**	**Good**	**Excellent**
Access technology partner	11,8%	5,9%	23,5%	52,9%	5,9%
Partner option assessment	5,9%	29,4%	52,9%	5,9%	5,9%
Partner selection	17,6%	35,3%	47,1%	0%	0%

Table 25. Indicator performance.

Patent portfolio

There seems to be a pattern in the response for the portfolio function of patents, at least, in the first three items as displayed in the corresponding table. For the number a patent claim, the uniqueness of the patent portfolio and the technical range of the citations in the portfolio there almost seem to be a normally

distributed. A plausible explanation for this would be the nature of the questions. Accept for the technical knowledge it would require to answer these questions, the answer scales are formulated as statements with a neutral option. So it could be that respondents that don't know exactly how the patent portfolio is composed would be more likely to respond with a neutral answer. It would therefore be best to map the functions of the representatives of the companies that are involved. This is a more general comment of course, and will be discussed in the conclusions further.

	Poor	Fair	Average	Good	Excellent
Patent claims	17,6%	17,6%	58,8%	0%	5,9%
Portfolio uniqueness	5,9%	17,6%	52,9%	17,6%	5,9%
Technical range citations	11,8%	17,6%	52,9%	11,8%	5,9%
Portfolio diversification	5,9%	11,8%	29,4%	47,1%	5,9%

Table 26: Portfolio performance.

Luckily the diversification topic shows a more distinct answer pattern. Perhaps as a broader topic this is easier to answer. Although the average score is still a large part of the response (29,4%), 47,1% states that they have a diversified technology portfolio in their firm. Performance wise this is a good score, considering a diversified portfolio in a primary technology or in broadly defined technology categories grants the company a competitive advantage.

Comments

Below are listed the most important comments from respondents that can possibly help build a better questionnaire in the future:

- You should give the opportunity not to answer a question because not all questions are relevant for everyone and also sometimes one does not know the answer.
- Too many variations per business to give a single answer, therefore often 'in the middle between the extremes'.
- This questionnaire asks the respondent to submit confidential data (such as licensing considerations).

The comments mentioned above together with the comments listed below the maturity results will be converted to recommendations in the next chapter. The idea is that these comments together with the results will provide useful information to adapt the questionnaires for future studies.

4.4 Comparing sets

As described in the last paragraph there are a lot of descriptive results per questionnaire that not only tell us something about the patent management practices of the target population, but also give important feedback for future research. The idea is of course to say something about the relationship between the two sets. Because of the relatively small target population and sample it is not unthinkable that this will have a negative

effect on the reliability of the variables involved, without necessarily saying something about the coherence between individual items. Therefore, in the following sub paragraph the two sets are compared by presenting the mean of each variable. Significant differences will be compared using company size to investigate the origin.

4.4.1 Maturity versus Performance

To create a simplistic overview, the mean of each individual variable for the maturity and performance concept are presented in the table below. As described in the theoretical framework and the results the choice was made to translate the survey results to predetermined scales.

	Maturity	**Performance**
Patent function	*Mean (1-4)*	*Mean (1-5)*
Incentive	Reactive (2)	Average (3)
Appropriation	Active (3)	Good (4)
Protection	Active (3)	Good (4)
Dissemination	Pro-active (4)	Good (4)
Asset	Reactive (2)*	Average (3)
Liability function	Active (3)	Poor (1)*
Performance indication	Active (3)	Average (3)
Portfolio	Reactive (2)	Average (3)
*Unreliable result due to single usable item in questionnaire		

Table 27. Comparing maturity and performance functions.

For maturity this is the planning attitude scale, and for performance all of the answers were labeled according to a general way of presenting performance measure. Although not a perfect fit, it does present someway to compare both sets. If you look at table, all but the liability function show parallels on maturity and performance. It must be mentioned of course that the results here are average's, meaning that deviations in individual items can have an influence on the end result. But, this is for both maturity and performance alike.

From these results no conclusions are drawn from regarding the research questions. There of course may be many other factors that contribute to the scores on maturity and performance. Some of the factors may include the company size. In the next paragraph a brief look at the company size is presented.

4.4.2 Company size

There are of course other ways to compare both sets. In the research model, firm characteristics are expected to be a moderating variable for the relationship between the independent en depend variables. In the next paragraph it is checked whether the variables in this study are reliable enough for a correlation analysis.

However, it is possible to compare both sets on a descriptive level as well. From the firm characteristics selected in this research, company size is a good way to compare both sets with. For this study, the company size is expressed in the number of employees.

Function	Between 5 and 20 employees	More than 500 employees
Incentive maturity	Pro-active	Reactive
Appropriation maturity	Active	Active
Protection maturity	Pro-active	Pro-active
Dissemination maturity	Active	Pro-active
Asset maturity	Inactive	Inactive
Liability function maturity	Inactive	Pro-active
Performance indication maturity	Pro-active	Reactive
Portfolio maturity	Inactive/Active	Active

Table 28. Effect of company size on maturity functions.

In the table above you can see that companies with 5 to 20 employees are compared to companies with over 500 employees. The goal here is to show per maturity patent function which strategic planning attitude was favored in both employee categories. In the original answer model the 'less than 5 employees' option was included, but none of the companies seem to have less than 5 employees (see the response analysis at the beginning of this chapter). For example, if you look at the incentive function you can see that companies with more than 500 employees favor a reactive planning attitude.

If you look at the total results it is remarkable that for the incentive and performance indication function smaller companies actually favor a more active strategic planning attitude. This is peculiar, because you would expect larger companies to have more mature practices. Logically these results could have two explanations:

- For specific functions company size is less important.
- Or, the questions that are used to measure specific functions are not attuned enough to larger companies.

Though for both points valid arguments can be made it seems that the second point is more plausible since the original questionnaire did not yield any mature responses amongst SME's. Furthermore, the background and theoretical framework of the study indicate that larger companies will probably have more mature patent practices.

Function	Between 5 and 20 employees	More than 500 employees
Incentive	Average	Good
Appropriation	Average	Good
Protection	Average	Good
Dissemination	Good	Good
Asset	Good	Good
Liability function	Poor	Poor
Performance indication	Average	Average
Portfolio	Average	Average

Table 29. Effect of company size on performance functions.

The same analysis can be made for the performance of patent functions. As opposed to the maturity functions, larger companies score equally or higher than smaller companies. You would expect larger companies to perform better at patent function. Because this study focuses on larger companies you can compare the results of these larger companies with each other. What you see is that roughly the same distribution for maturity and performance as in the analysis for the entire response group (see 4.4.1). This is not so strange, given that the larger companies represent almost 70% of the entire response group. The biggest differences are in the:

- Incentive function.
- Liability function.
- Asset function.

It is remarkable that for the incentive and asset function the scores on performance are higher than maturity. This could indicate that for larger companies the maturity of practices of a patent function does not determine the performance of patent functions. Again, this could also mean that the questions that are used to measure specific functions are not attuned enough to larger companies.

4.5 Correlation

Correlation and regression analysis are two techniques that can be used if a (linear) relationship between the two (or more) interval or ratio variables is assumed. If feasible, both of these analyzes will be applied to the relationships between variables such as these have been shown in previous chapters, provided to be reliable for further analysis. If these variables are reliable enough they can be used for correlation and regression analyzes corresponding with hypotheses in the second chapter.

4.5.1 Reliability

The reliability of a measurement can be defined in different ways. Usually refers to reliability whether you do or do not get the same results if you use a tool to measure something more than once (Bernard, 2000, p. 47). Reliability cannot guarantee the validity of a measurement but can be seen as a condition for correlation and validity.

Function	**Maturity reliability**	**Performance reliability**
Incentive	0,561	0,528
Appropriation	0.684	0,521
Protection	0,507	0,704*
Dissemination	0,541	0,843*
Asset	-**	0,862*
Liability function	0.146	-**
Performance indication	0,485	0,823
Portfolio	0,797	0,475
* Cronbach's alpha after removing one item ** Unreliable result due to single usable item in questionnaire		

Table 30. Cronbach's alpha for maturity and performance functions.

Cronbach's alpha can be used to check whether a collection of data is reliable using a statistical test to check how well items in a particular scale correlate with each other (Bernard, 2000, p. 298). The Cronbach's alpha is always between 0 and 1, whereas the minimum score in social sciences is often regarded to be 0.7. With a lower score certain items can be modified or omitted to see if the scores ends up higher. The reliability of the different variables is reviewed and discussed in this section to check the possible for a correlation analysis. The results of the reliability analysis for each variable were created using SPSS and can be found in the annex. In the table below can be seen which variables are reliable enough to perform correlation studies on.

Maturity

Unfortunately two variables of the maturity concept can be considered reliable enough for further analysis. These are the appropriation and portfolio function. Accept for the liability function, which scores a very low reliability, the other scores are situated around 0,5 on the reliability results. In the original questionnaire the liability function was not incorporated. For this study, an attempt was made the recreate the liability function in the questionnaire using an existing model in theory. It appears that the internal consistency for the items in this variable are low, and that in future research this variable will most likely be rebuild. The low reliability on the liability function and the other functions can be contributed to multiple generic reasons:

- First, the small population and sample can result in a distorted picture. The original questionnaire was thoroughly tested, so you would think that the items show at least the minimum for reliability. This could indicate that the low statistical power has a negative effect on reliability. In the original study by Kern & van Reekum (2007) all the functions except for liability were found reliable enough. The liability function was no tested for reliability because no questions made it into the questionnaire (see paragraph 2.1.4). Therefore no questions were changed for the seven functions in the original study. For the liability functions new questions were derived from literature. However, it seems that these questions are not reliable enough.
- Secondly, it seems that it is in most cases not detailed enough yet. As described in the interviews, large multinationals bring all sorts of nuances to the theoretical concepts. In one of the comments on the questionnaire, a respondent of the survey research argued: “Some concepts found in textbooks and papers are not as black and white as they appear to be. Although in this research an effort has been made to indicate the shades of grey, there are many more, and in most industries there is even a whole different palette of colors”.
- Due to the large processes, even a director of intellectual property may not know every detail, for example, the amount licensing contracts. However, the same director will have a very detailed image about the dissemination of patent information in the organization. For companies with 500 or more employees, the patent process should be investigated in depth. When this is done a questionnaire should be designed for employees in different levels of the firm to find the right expertise on each function for example.

Performance

Quite different from the maturity concept, variables in the performance study show higher reliability. Four functions are reliable enough after removing one item. In the appendices it is possible to see which items were removed. These items will also be highlighted in the upcoming section regarding recommendations for future research.

One score (or actually 'no score') stands out, this is the liability function. The reason no score for reliability could be achieved here is that for the 'infringement claims' and 'loan acquirement' items almost all the respondents answered the lowest scale, indicating that something is wrong with these questions. It could be in the question or in the answer model, but for future research these questions need to be adapted. This leaves only the incentive, appropriation and portfolio function that will need some tweaking in the future.

Although many existing questions were used it still is difficult to achieve reliable results for the purpose of this study. Of course, in an ideal situation all of the variables would be reliable, but given the exploratory angle of the study, it is good to see that there is a foundation on which future research can be built.

Conclusion

The conclusion of the results presented here is that there are no variables for both concepts that are both reliable enough for further statistical analysis. Because this is a pilot study it could be expected that due to the amount of respondents it would be difficult to prove correlation and regression for the variables.

As mentioned in the first chapter the decision was made to choose for an explanatory research question. This was done to provide this thesis with a clear sense of direction and to come as close to a model and method to measure the performance of patent management now and in the future. Ideally it would have been best to find a correlation between each of the variables for maturity and performance, but this is not possible with the current results.

Unfortunately this means that the research question remains unanswered at this point. It appears that a correlation and regression study for the variables in this study is still one bridge too far.

5. Conclusion, discussion and recommendations

The main conclusions are presented in this chapter. In addition, there is a discussion, and recommendations are done based on the results. The conclusions refer to the theoretical framework, the corresponding conceptual model and the research questions. The discussion will focus on the methods used in this study and the limitations. Because this is a pilot study the recommendations will focus a great deal on the improvement of theoretical concepts and methods.

5.1 Conclusion

The central question of this research is: 'Do companies with mature patent functions also score higher on the performance of those functions?'. As discussed in the first chapter and in the theoretical framework, this question is formulated this way because it is expected that there is a positive relationship between the independent (maturity) and dependent variable (performance). Ideally it would have been best to find a correlation between each of the variables for maturity and performance, but this is not possible with the current results. Unfortunately this means that the research question remains unanswered at this point.

However, because it this is a pilot study the main challenge is not to test for correlation and regression, but to find a performance measure for patent management practices. An attempt has been made to find a set of indicators that can measure the outcome of a firm's strategic patent management activity. The starting point of this assignment is the Patent Management Maturity Model developed by Kern and van Reekum (2007). The model produces the maturity on eight functions a patents have in a company. Per function can be deduced how mature the patent management practices are based on four planning attitudes. For this study, the liability function of patents was redesigned and added to the questionnaire.

Function	**Maturity**	**Performance**
Incentive	Reactive	Average
Appropriation	Active	Good
Protection	Active	Good
Dissemination	Pro-active	Good
Asset	Reactive	Average
Liability function	Active	Poor
Performance indication	Active	Average
Portfolio	Reactive	Average

Table 31. Average scores on patent functions based on descriptive results.

For the performance measure it would have been easier way to just to look at economic factors, and compare firms based on that. The problem with that approach is that it is very difficult to prove a direct relation exist between the attitude and implementation towards patent management practices and general economic indicators. To provide a step in-between, the performance of each of the eight patent functions was

investigated. The measurement for performance on each function was derived from literature, with the idea to build as much as possible on existing questions and scales.

To test the model, two questionnaires (one for each concept) were distributed amongst 55 companies, of which roughly 70% consist of companies with more than 500 employees. Response for both questionnaires topped near 30% for each questionnaire, and can be considered high. Given the high response rate, results can be transferred to the sample. However due to the small sample, results cannot be generalized beyond this study.

Function	**Maturity**	**Performance**
Incentive	Commercialization of results that fall outside the company strategy are not stimulated and the initiative lies with the employee.	Contribution by employees to commercialization is poor.
Appropriation	The initiative to patent R&D results lies with a patent attorney and/or managers and/or researchers.	If an application is done, a patent is almost always granted.
Protection	Infringement in counteracted with internal capacity, whereby external expertise can be acquired for special cases.	Patent protection is very effective. litigation is pursued when a strong case is made, and outcome is expected to be favorable
Dissemination	Patent information is used as input for ideas and/or own specific research and to gain insight in the strategy of competitors.	Employees in most of the use patent information only occasionally, support by patent staff is good.
Asset	Patents are hardly financially appreciated.	The economic value of patents is good, while for the strategic value the score is average.
Liability function	Initial costs are seen as investments, not costs. The development of new products is done according to the product life-cycle paradigm.	Patents are not used to acquire a financial loan. The invention to innovation rate is high.
Performance indication	Patent portfolios have low priority in evaluating potential partners.	the option assessment and selection of potential partners is hardly based on patent information
Portfolio	Patents are evaluated based on financial potential/return and strategic importance	Portfolio uniqueness and diversification are average.

Table 32. A summary of the most significant descriptive results.

The summary of the most significant descriptive results can be found in the table 32. If you look at table, all but the liability function show parallels on maturity and performance. It must be mentioned of course

that the results here are average's, meaning that deviations in individual items can have an influence on the end result. Regardless of other factors that may influence these results, it seems from a descriptive point of view that maturity and performance go hand in hand. Per item there are of course a lot of results that are very interesting, especially given the high representativeness of the sample. An overview of the most significant descriptive results on those items can be found in the table 33 above.

The main objective of this research is to develop and test a model. To facilitate this purpose, two interviews were held with patent specialist of two multinational companies. These specialists are responsible for the IP management in their respective companies. Accept for some minor changes to sentences and specific technical terms no changes could be made based on these interviews. This information is used in the discussion en recommendations paragraphs below. Although the interviews provided very useful information, it is difficult to gage whether the questionnaires cover all of the areas of maturity and performance in scientific literature.

What can be learned from this study is not so much what the strength of the correlation between each of the variables for maturity and performance is. Because of the small sample, empirical insights can only provide some sense what the maturity and performance of large patent-intensive companies is. The value of this study however lies in the model en method. Kern and van Reekum (2007) argue in their study: "operationalization of the framework underlying it provides a rare conceptualization of the organization of strategic patent management, leveraging knowledge of large companies' practices". The same can be said for this study. With some adaptions the model and questionnaires can be used by companies in patent-intensive sectors to gage the attitude towards and performance of the use of patents, presenting recommendations to the management for policy considerations.

In summary the most significant conclusions of this study are:

- A model and method have been developed to measure the maturity (independent variable) and performance (dependent variable) of strategic management in large patent-intensive companies.
- An empirical study has been done to test both the model and method. Two senior patent specialists were interviewed and 20 large patent-intensive companies participated in the survey research.
- From a subjective point of view a lot of items in both the questionnaires seem to cover the maturity and performance of patent management (face validity). For example, both expert interviewees deemed the questions relevant. However, as described in the interviews, there are all sorts of nuances to improve both the theoretical concepts and method.
- Due to the small sample it is not possible to generalize results. However, descriptive results from both the survey and interviews provide a unique glimpse in the organization of patent management of the participating companies.
- There are no variables for both concepts that are both reliable enough for further statistical analysis. Unfortunately this means that the research question remains unanswered at this point. However, recommendations for future research can be made based on the results.

5.2 Discussion

This discussion will focus on the model and methods used in this study. Two methods were used in this study, expert interviews and a survey study. The interviews were used to gather information from patent specialists about the two questionnaires used in the survey study.

From both interviews a substantial amount of significant information was collected. The problem with these interviews is that due to the difficulties with the planning of the interviewees, the information of these interviews could not be implemented into the questionnaires beforehand. However, the use of this method does help eliminate the mono-method bias, and contributes to the recommendations for future research in a significant way. In both interviews loads of comments were made to individual items. These comments can be found in the appendices.

The difficulty in the survey research was to find respondents. Countless efforts were made to contact firms directly or via communities. The original idea to contact different people on different levels within each company was abandoned when an opportunity came along to contact a community of patent specialist working for patent intensive companies. This group proved to be the ideal target population, and after corresponding with the secretariat, the questionnaires were sent to the companies who could fill them in anonymously. Given the high response rate it only possible to say something about the organizations involved.

But what does this mean for both questionnaires? If you combine both the information from the survey and (especially) the interviews generalized statements can be made about the methodology. The idea is that these statements can help build a better research in the future. These methodological considerations from this study are:

1. Correlation between independent and dependent variables. It expected that part of the reason why this research is unable to statistically test the relationship between the maturity and performance for patent functions is because of the small sample. This can result in a distorted picture.
2. Generalization of research results. Given the high response rate, results can be transferred to the sample. However due to the small sample, results cannot be generalized beyond this study.
3. Specification and selection of questionnaire items. As described in the interviews, large multinationals bring all sorts of nuances to the theoretical concepts. For the maturity questionnaire it means that items do not always capture the depth of practices for larger companies. Practically this means that the list of possible answers for a question is not always complete. Furthermore, policies may vary per business within the company, so often there is not one right answer, but multiple could apply.
4. Function and position of employees. For both questionnaires the function of the respondent is not taken into account. This means that questions could possibly go beyond responsibilities and/or knowledge level. Therefore for the respondents filling in the questionnaires it could be 'convenient' to give an answer that is in the middle between the extremes.
5. Sectorial or national differences. Such differences are caused by factors like laws and regulations, entrepreneurial spirit, technological regimes, patent awareness, public R&D, innovation policies, etc. (Kern & Reekum, 2007). In the sample organizations operating in different sectors and nations are represented. What the effects are of these differences is not taken into account in this study.

These are of course general issues that reflect on both questionnaires as a whole. However, if you look at the reliabilities scores for maturity and performance improvements can be mentioned on a functional level. In table 34 the reliability scores on both concepts are displayed. Below issues for both maturity and performance are addressed on the patent function level.

Function	Maturity	Performance
Incentive	Unreliable	Unreliable
Appropriation	Reliable	Unreliable
Protection	Unreliable	Reliable
Dissemination	Unreliable	Reliable
Asset	Unreliable	Reliable
Liability function	Unreliable	Unreliable
Performance indication	Unreliable	Reliable
Portfolio	Reliable	Unreliable

Table 33. Reliability scores on maturity and performance functions.

5.2.1 Maturity functions

Unfortunately two variables (functions) of the maturity concept can be considered reliable enough for further analysis (appropriation and portfolio functions). If you look at the interviews and survey results different issues with the other six functions arise, these are displayed in table 34 above. Is does not automatically mean that these issues are the main reason for the unreliable results (see the general considerations in the previous section), but it is likely that they can contribute to a better questionnaire.

Function	Issues from Interview results	Issues from survey results
Incentive maturity	The idea that employees commercialize research results outside the strategy of the company is outdated due to contractual restrictions.	Rewards are fixed in countries where this is regulated by law. Therefore some answers could possibly not apply for all companies.
Protection maturity	The consideration to pursue litigation is based only on a cost/benefit analysis.	The question concerning litigation is difficult answer given the answer options.
Dissemination maturity	The list of possible answers is to measure the use of patent information is not exhaustive enough.	Different interpretations of the term 'work meetings' possibly give distorted results.
Asset maturity	The answer model for financial appreciation is too far from reality.	Unreliable result due to single usable item in questionnaire.
Liability function maturity	The answer model is too difficult to understand.	Companies don't use patents as collateral for a financial loan.

Function	Issues from Interview results	Issues from survey results
Performance indication maturity	The concept of patent communication is not explored deep enough.	Not taken into account that some communication about patent information is mandatory, other is confidential.

Table 34. Considerations on improving the maturity concept.

5.2.2 Performance functions

Different from the maturity concept, variables in the performance study show higher reliability. For four patent functions the reliability was not high enough. For these functions several issues are worth mentioning, these can be found in table 36. Again, the distinction is made between survey and interview results.

Again, it does not automatically mean that these issues are the main reason for the unreliable results (see the general considerations in the previous section), but these issues presents an opportunity to improve on the questionnaire. These improvements, or recommendations, are presented in the next paragraph.

All the suggestions on detailed level can be found in the appendices in the interview and survey results.

Function	Improvements from Interviews	Improvements from survey results
Incentive performance	For large companies it is difficult to track the involvement of employees in commercialization.	In larger companies contribution to patents is part of the job description and rewards are not substantially.
Appropriation performance	There are more forms of innovation and licensing than is incorporated in the current theory/operationalization.	When the decision is made to patent, and an application is often filed, this could be due to the nature of the process.
Liability performance	For some companies the requested information is considered confidential.	The assumption that companies use patents as collateral for a financial loan is outdated.
Portfolio performance	The list of possible answers is to measure the diversification of patent portfolios is not exhaustive enough.	The measure to answer some of the statements can be considered too subjective. Furthermore, some of the technical terms used in the question are not clear enough.

Table 35. Considerations on improving the performance concept.

5.3 Recommendations

As described in the previous paragraph this study can help to rate the performance of patent functions in the future. Because this is a pilot study, recommendations focus on improvements that can be made on both the

maturity and (especially) the performance questionnaires. These recommendations follow logically from the previous analysis and discussion. In the previous section generalized statements were made about methodology. These translate into the following recommendations for future research:

1. Test the relationships proposed in the research question. This means statistically test the relationship between the maturity and performance for patent functions. Basically this means a larger sample. But it could also means designing scales similar to the maturity questionnaire (e.g. a 4-point scale). More importantly perhaps is to adapt questions related to individual functions (see paragraph 5.3.1 and 5.3.2). This is of course the red line through most of the recommendations.
2. Account for generalization of research results. For this issue the recommendation is the same as above: increase sample size so results can be generalized beyond this study. This also means tighter definitions of the target population and sample.
3. Improve the validity of questionnaire items. Make sure questionnaires are more suited for larger companies with employees that have a more complete understanding of patent management systems. This means digging dig even deeper in the process, identifying all the 'colors' of patent management. It can be concluded that information from textbooks and scientific journals do not fully capture the depth of the patent management practices for large multinationals operating in very different markets. It is recommended to do follow-up interviews regarding improvements made to the questionnaires. It would be best to meet with leading experts in the patent management field and walk through the patent process, identifying key actors and control measures. Another suggestion is to provide room for respondents to fill in their own answers and to provide options to decide on a case to case basis.
4. Account for function and position of employees within the company. It does not mean adapting the questions for multiple groups, but identifying which questions can be answered by which employees and distribute the questions accordingly. For example, a director of IP will probably know different information than a researcher. It also means improving on some of the technical terms that are used, so that there are understood by the target audience. Guiding in making a distinction based on function and position is to address the difference between exploitation and commercialization of patents.
5. Assess sectorial and/or national differences. What the effect are of these difference should be taken into account for future study.

These are of course general recommendations that reflect on both questionnaires as a whole. However, if you look at paragraph 5.2.1 and 5.2.2 improvements can be made on a functional level. Below recommendations for both maturity and performance are addressed on the patent function level.

5.3.1 Maturity functions

In the previous paragraph issues were discussed concerning the unreliable maturity functions. Based on these issues specific recommendations can be made to improve on these functions.

Sometimes these recommendations require a closer look at theoretical concepts; however there are also recommendations that suggest improvements on the operationalization of the questionnaire. These

recommendations build heavily on the comments of the survey results and in particular the interview results. In these interviews a lot of suggestions were made that capture the practices of MNE's.

Function	Recommendations
Incentive maturity	Ask for commercialization of research results that takes place in accordance with strategy and core business. Ask specifically for the inventive scheme. In this scheme the rewards for contributing in the realization of for example patents are described.
Protection maturity	Account for risk analyses (or clearance assessments) that are usually done in preventing infringement. Circumvent confidentiality issues by rephrasing corresponding questions.
Dissemination maturity	It should be more specific what is meant by work meetings. Incorporate different was the dissemination of patent information takes place (e.g. internally, subscription or specialists).
Asset maturity	Redesign this function resulting in questions that come closer to the way companies actually (financially) appreciate their patents.
Liability maturity	Clearly define and simplify the questions concerning the freedom to operate and the level of newness. Find a new way to measure financial liability.
Performance maturity	Ask respondents specifically about the extent to which communications about patent take place (e.g. patent acquisition, patent portfolio's and annual reports/publications).This the mandatory versus confidential types of information are circumvented.

Table 36. Recommendations for specific maturity patent functions.

In the appendices a first attempt has been made to incorporate some of these recommendations into an improved version of the original questionnaire. The difficulty however lies in the answer models of the questions related to each function. Every answer possibility is specifically designed for a question and fits in the strategic planning attitude paradigm. To change a question only slightly is to change the answer model. This in turn requires new theoretical (and possible empirical) insights that fall out of reach of this study.

5.3.2 Performance functions

Of course for the issues with the performance functions it is also possible to provide recommendations. In the table below these recommendations are presented. In the appendices a first attempt has also been made to incorporate some of these recommendations into an improved version of the performance questionnaire. This is less difficult compared to the maturity questionnaire because of the questions and answer scales were designed in this research. Hopefully the insights and recommendations presented in this chapter can help to build a better tool for measuring the maturity and performance of patent management in the future.

Function	Recommendations
Incentive performance	Ask researchers specifically who move further with the project their involved in about commercialization activities. Or, ask employees that focus on

Function	Recommendations
	commercialization about their activities. Ask respondents about portals were information can be found on IP management (e.g. reward scheme's)
Appropriation performance	There is a high diversity in innovations. And lot of these innovations do not lead to patents (e.g. in manufacturing). Therefore questions should address this diversity. Beware that there is also lot of diversity in licensing contracts. Account for business model because it determines the type of contract. Furthermore, licensing can also be a result of coercion from the law, or cooperation to form cross-licenses (e.g. medical semi-conductor industry).
Liability performance	A better way to gage the liability here would be to know what part (percentage) of the inventions leads to an actual patent. This would circumvent potentially confidential information. To address the financial loan it would be better to ask if the IP portfolio used as collateral.
Portfolio performance	Improve in defining technical term such as 'patent claims', 'patent citations' and 'diversified patent portfolio'. For the last term, indicate the difference between a diversified portfolio and a focused one. The term 'high' is frequently used in the answer model. To respondents this can be considered to be a too subjective measure. It would be good to replaced it by a term that specifies to a greater extent what is meant by this concept.

Table 37. Recommendations for specific performance patent functions.

The road to this ambition has fortunately provided a lot of new information on how to measure dimensions of patent management. So far there has little research that explicitly tackles the patent management performance issue on a different level. In these insights combined with recommendations for future research lies the value of this research.

References

Ackoff. (1981). *Creating the corporate future: plan or be planned for.* New York: Wiley.

Arundel, A., & Kabla, I. (1998). What percentage of innovations are patented? Empirical estimates for European firms. *Research Policy* , Vol. 27, pp. 127–141.

Ashish, A., & Ceccagnoli, M. (2006). Patent Protection, Complementary Assets, and Firms' Incentives for Technology Licensing. *Management Science* , pp 1-38.

Babbie, E. (2007). *The practice of social research.* Belmont: Thomson Wadsworth.

Bernard, R. (2000). *Social Research Methods: Qualative And Quantative Approaches.* Sage Publications.

Brouwer, E., & Kleinknecht, A. (1999). Innovative output, and a firm's propensity to patent. An exploration of CIS micro data. *Research Policy, 28* , 615-624.

Drury, C. (2008). *Mangement and Cost Accounting.* Cengage Learning.

Ernst, H. (2003). Patent information for strategic technology management. *World Patent Information* , Vol. 25, pp.233–242.

Gambardella, Harhoff, & Verspagen. (2008). The value of European patents. *European Management Review* , Vol.5, 69-84.

Geringer, J. M. (1991). Strategic Determinants of Partner Selection Criteria in International Joint Ventures. *Journal of International Business Studies* , Vol. 22, No. 1, pp. 41-62.

Germeraad, P. (2003). Measuring R&D in 2003. *Research Technology Management* , pp, 47-56.

Goldense, Schwartz, & James. (2005). *As more companies use more R&D metrics, the "top five" metrics remain the same, according to research study.* Retrieved from Goldense Group, Inc: http://www.goldensegroupinc.com/CompPub/Articles/A56.pdf

Hitt, M., Hoskisson, R., Ireland, D., & Harrison, J. (1991). Effects of Acquisitions on R&D Inputs and Outputs. *The Academy of Management Journa* , Vol. 34, No. 3, pp. 693-706.

Horstmann, I., MacDonald, G. M., & Slivinski, A. (1985). Patents as Information Transfer Mechanisms: To Patent or (Maybe) Not to Patent. *Journal of Political Economy* , Vol. 93, No. 5, pp. 837-858.

Johnson, Cohen, & Junker. (1999). *Measuring appropriability in research and development with item response models*. Retrieved from Carnegie Mellon Statistics Department Technical Report: http://www.stat.cmu.edu/

Kern, s., & Reekum, R. (2007). *The Use of Patents in Dutch Biopharmaceutical SME: a Typology for Assessing Strategic Patent Management Maturity .*

Lin, B.-W., Chen, C.-J., & Wu, H.-L. (2006). Patent Portfolio Diversity, Technology Strategy, and Firm Value. *IEEE Tansactions on Engeneering Management* , Vol. 53, No. 1, pp 17 - 26.

Loch, & Tapper. (2000). *R&D Performance Measures That Are Linked To Strategy.* Retrieved from INSEAD: http://www.insead.edu/facultyresearch/research/doc.cfm?did=47577

McGahan, A., & Silverman, B. (2006). Profiting From Technological Innovation by Others:The effect of competitor patenting on firm value. *Research Policy* , Vol. 35, 1222–1242.

Nelson, A. (2009). Measuring knowledge spillovers: What patents, licenses and publications reveal about innovation diffusion. *Research Policy* , Vol. 38, 994–1005.

Reitzig, M. (2004). Improving patent valuations for management purposes - validating new indicators by analyzing application rationales. *Research Policy 33* , 939–957.

Roth, N., & Evans, S. (2002). *Performance measurement to improve knowledge reuse and invention.*

Sandal, N., & Kumar, A. (2011). Role of Freedom to Operate in Business with Proprietary Products. *Journal of Intellectual Property Rights* , Vol 16, pp 204-209.

Scherer, F. (1983). The propensity to patent. *International journal of Industrial Organization* , 107-128.

Schwartz, L., Miller, R., Plummer, D., & Fusfeld, A. (2011). Measuring the effectiveness of R&D. *Research Technology Management* , pp, 29-36.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs: For generalized causal inference.* Boston: Houghton Mifflin Company.

Stinchcombe, A. (1965). Social Structure and Organizations. *Handbook of Organizations 7* , Chicago: Rand McNally & Co, pp. 142–193.

Trott, P. (2008). *Innovation Management and New Product Development.* Pearson Education Limited.

Uitvoeringsregeling octrooien. (2010). Retrieved from Universiteit Twente: http://www.utwente.nl/htt/octrooien/uitvoering_octrooien%20UT.doc/

van Reekum, R. (1999). *Intellectual Property in Pharmaceutical Innovation: A Model for Managing the Creation of knowledge under Proprietary Conditions.* Capelle a/d/ IJssel: Labyrint.

WIPO. (2011). *Global Innovation Index*. Retrieved from WIPO: http://www.globalinnovationindex.org/gii/

WON. (2008). *Werkgemeenschap Octrooi-informatie Nederland*. Retrieved from WON: http://www.won-nl.org/2008/public/nl/home.shtml

Wood, F. Q. (1992). The commercialisation of university research in Australia: Issues and problems. *Comparative Education, 28(3)* , 293-313.

Appendices

Appendix 1: Questionnaires

Patent management maturity questionnaire

First of all, thank you very much for participating in this online survey! We believe that with your help we can make a significant contribution to patent management. Although many large scale companies operating in technological advanced sectors will probably have many patent management activities, it is difficult to measure the maturity of these activities, and how these activities actually perform. With this survey we hope to make a small contribution to the solution of this problem. In this survey we will ask you about the maturity of patent practices within your company. Questions concerning these practices are categorized based on patent functions. The structure of this survey therefore is:
A: General information
B: Incentive
C: Appropriation
D: Protection
E: Dissemination
F: Asset
G: Liability
H: Performance indicator
I: Portfolio
Please answer all the questions listed under these categories. If you don't understand a question, or a question does not apply to your company, please skip this question and move on to the next. Good luck!

A: GENERAL INFORMATION

1. How many years does your company exist (approximately)?

Company existence

- Less than 5
- Between 5 and 10
- Between 10 and 20
- Between 20 and 30
- More than 30

2. How many employees does your company have (approximately)?

Employee count

- Less than 5
- Between 5 and 50
- Between 50 and 200
- Between 200 and 500
- More than 500

3. In what sector does your company's core business take place?

Sector information

B: INCENTIVES FOR TECHNOLOGICAL RENEWAL

4. What is the position of your company regarding employees who independently commercialize research results that fall outside the company's strategy?

Contribution to commercialization

- Resentful
- It is allowed, but not stimulated
- It is supported, but the initiative lies with the employee
- It is stimulated, and there is a strong focus from the company

5. Are there within your company explicit rewards for employees who (at least) have some share in the realization of patents?

Rewards

- No
- Yes, immaterial rewards
- Yes, fixed material or variable material rewards
- Yes, fixed material and variable material rewards

C: THE APPROPRIATION OF TECHNOLOGICAL KNOWLEDGE

6. From whom comes the initiative to patent R&D results?
Initiative
- From someone outside the company (e.g. partner or external patent organization)
- From a manager
- From a manager and/or researchers
- From a patent attorney and/or managers and/or researchers

7. Is the discussing patenting technological knowledge part of regular work meetings?
Work meetings
- No, it is not a part of regular work meetings
- Yes, work meetings by a patent specialist and management team after the invention is realized
- Yes, work meetings by a patent specialist and management team both before and after the invention is realized
- Yes, work meetings by a patent specialist and management team and researchers both before and after the invention is
- realized

8. To what extent within your organization is the patentability of research (results) a mandatory part of research proposals?
Research proposals
- Not mandatory
- Not mandatory, but it is appreciated
- Mandatory
- Mandatory, including a preview on exploitation

9. To what extent within your organization are property and exploitation rights of intellectual property defined in contracts?
Contract definition
- Not defined in contracts
- It is defined, but it differs per case, and there is no consult needed with stakeholders/experts within the organization
- It is defined, standard contracts are used in consultation with other stakeholders/experts
- The same, whereby compliance with contractual agreements is checked

10. To what extent is secrecy of research results formally regulated?
Secrecy
- There are no rules, nobody is responsible for supervising this
- It is a standard part of the labor contract of employees
- The same, but it is also part of the contracts of external capacity (e.g. post-docs)
- The same, whereby all employees are actually informed of these rules

11. To what extent is publication of research results arranged by regulations?
Publication
- There are no regulations, nobody is responsible for supervising this
- The same, but agreements for release are based on a case to case basis
- There are different regulations whereby a manager is formally responsible for release/authorization
- The same, whereby researchers are actually informed of these regulations

D: THE PROTECTION OF INTELLECTUAL PROPERTY

12. What is being done in your company to prevent infringement?
Infringement prevention
- Nothing
- To follow potential warnings from competitors
- To follow potential warnings from competitors, and send out warnings yourself
- Pre-emptive offering/asking (cross) licenses

13. In the existence of your company, has there been a situation where your company made an infringement on a patent of a third party?
Infringement
- yes
- no

14. In the existence of your company, has there been a situation where a third party made an infringement on a patent of your company?
Infringement third party

- yes
- no

15. In what way is tracking and fighting infringement regulated by your company?
Fighting infringement
- Not formally organized, differs on a case by case basis
- It is completely outsourced (e.g. to patent attorneys or other specialists)
- There is limited internal capacity for these activities, and is complemented for an important part with external expertise
- It is conducted largely by internal capacity, whereby external expertise can be acquired for specific inquiries

16. When does your company decide to pursue litigation?
Litigation
- No litigation
- Only when the economic effects of infringement are felt
- In principle always when infringement is detected
- Only when no other option is available

E: THE DISSEMINATION OF TECHNOLOGICAL KNOWLEDGE

17. To what extent is information from patents/patent databases used by your organization?
Information use
- Not at all
- Only for evaluating the chances of own patent applications
- For patent applications, but also as input for ideas and/or own specific research
- The same, but also to gain insight in the strategy of competitors

18. In what way does the dissemination of patent information take place within your company?
Dissemination
- There is not an information source available within the company
- Patent information is available from a central point (e.g. open patent database) and use is based on own initiative
- Information is structurally provided by an assigned person but on his or her own initiative
- Information is structurally provided by an assigned person but also on initiative of the researcher

F: FINANCIAL APPRECIATION

19. How are patents financially appreciated in your company?
Appreciation
- No financial appreciation
- Patents are valued based on manufacturing or purchasing costs
- Patents are valued for external accounting (e.g. financial statements) based on manufacturing or purchasing costs and for
- internal reports based on cost price plus a standard profit margin
- Patents are valued for external accounting (e.g. financial statements) based on manufacturing or purchasing costs and for internal reports based on expected return (market potential)

G: LIABILITY

20. In facing (future) infringement claims, to what extent are 'Freedom to Operate' (or similar) analyzes used in your company?
Freedom to operate
- When infringement is claimed the activities are stopped and/or the litigation is resolved by settlement
- An analysis is conducted after infringement is claimed to prevent future litigation
- An analysis is done. When (possible) infringement is found the problem is circumvented or the project canceled
- An analysis is done. When (possible) infringement is found, circumvention is an option, as well as acquiring a license or patent

21. How would you value the amount of effort (time, money, R&D) that is put into the development of new technologies?
Liability of newness
- R&D in new products is avoided. The organizations efforts are aimed at improving and evolving the proven products
- R&D for new products is started when technological rivalry is assessed on the basis of patent info
- Alternatives assessed before investing

- Initial (R&D) costs are seen as investments, not as costs. The (strategic) development of new products is done according the product life-cycle

22. To what extent does your company use patents as collateral for a financial loan?
Patent loan
- Does not use patents as collateral to obtain a loan
- The patent (portfolio) is valuated, but is not used as collateral
- On request of a financier a patent is used to obtain a loan
- The organization uses patents to obtain a loan

H: THE USE OF PATENTS FOR PERFORMANCE INDICATION

23. To what extent are patent portfolio's used to evaluate the attractiveness of potential partners?
Potential partners
- Not taken into account in evaluation
- Low priority in evaluation
- High priority in evaluation
- Highest priority in evaluation

24. To what extent is there communication by your company regarding patents and/or patent applications?
Communication
- None
- Only external after the patent is granted
- Only external, both after a patent is granted and after filing for a new application
- The same, but also internally

I: PATENT PORTFOLIO'S

25. In what way is taken in account the size and composition of the existing patent portfolio with a new patent (application)?
Portfolio
- Not at all, the patent application procedure is started when patentability is feasible
- If there is a technological connection
- If there is a technological connection as well as a commercial connection
- Based on audits, research proposals are provided with patent paragraphs

26. To what extent is the existing patent portfolio evaluated in your company?
Portfolio evaluation
- There is no evaluation
- Based on costs
- Patents are evaluated based on financial potential/return
- Patents are evaluated based on financial potential/return and strategic importance

27. From whom comes normally the initiative for licensing?
Licensing initiative
- No one, there are no licensing activities
- From third parties
- From third parties and management
- From third parties, management and researchers

28. In the last five years (or from the start of your company if younger than five years), how many licenses were granted by third parties?
Company licenses
- None
- Less than 5
- Between 5 and 20
- More than 20

29. In the last five years (or from the start of your company if younger than five years), how many licenses were granted by your company?
Third party licenses
- None
- Less than 5
- Between 5 and 20
- More than 20

30. Do you have any remarks?
Remarks

You have completed the first part of the survey. Please fill in the questionnaire on patent management performance as well. Thank you very much for your participation!
Please press 'Done', and you can close the new window afterwards.
For additional information or questions about the survey or results please contact:
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Dexter Nijmanting (d.p.nijmanting@student.utwente.nl)
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Patent management performance questionnaire

First of all, thank you very much for participating in the online survey! We believe that with your help we can make a significant contribution to patent management. Although many large scale companies operating in technological advanced sectors will probably have many patent management activities, it is difficult to measure the maturity of these activities, and how these activities actually perform. With this survey we hope to make a small contribution to the solution of this problem. In this survey we will ask you about the performance of patent practices within your company. Questions concerning these practices are categorized based on patent functions. These functions determine the following structure:
A: Incentive
B: Appropriation
C: Protection
D: Dissemination
E: Asset
F: Liability
G: Performance indicator
H: Portfolio
Please answer all the questions listed under these categories. If you don't understand a question, or a question does not apply to your company, please skip this question and move on to the next. Good luck!

A: INCENTIVES FOR TECHNOLOGICAL RENEWAL

1. From the employees who have (at least some) share in the realization of patents, approximately what percentage contributes in some way to the commercialization of research results?
Contribution to commercialization
- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

2. From the employees who have (at least some) share in the realization of patents, approximately what percentage are aware of the policy of concerning inventions made by employees?
Policy awareness
- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

3. From the employees who have (at least some) share in the realization of patents, approximately what percentage are aware of the compensation structure that is in effect regarding patenting within the company?
Compensation awareness
- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

B: APPROPRIATION OF TECHNOLOGICAL KNOWLEDGE

4. In the last five years, approximately a patent application was filed for approximately what percentage of your company’s product and process innovations?
Patent application
- 0-20%
- 21-40%

- 41-60%
- 61-80%
- 81-100%

5. In the last five years, approximately for what percentage of your patent applications was a patent actually awarded?

Patent awarded

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

6. In the last five years, approximately what percentage of your company's patents resulted in licensing contracts?

Patent contracts

%

7. In the last five years, approximately what percentage of your company's research results got published (e.g. through presentations, conferences and other channels)?

Publication results

%

C: THE PROTECTION OF INTELLECTUAL PROPERTY

8. During the last five years, what is your judgment about the effectiveness of various mechanism for protection of product (or service)/ process innovations against imitators?

Protection effectiveness

- Insignificant - Modest – Moderate -Very Important - Crucial

Time lead on competitors

Keeping qualified people in the firm

Secrecy

Patent protection

Complexity of product or process design

Copyright and related laws

Certification, normalization

9. In the last five years, approximately for what percent of the cases when infringement was identified was litigation prevented (e.g. by sending out a warning or by offering (cross) licenses)

Litigation prevention

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

10. In the last five years, when infringement was identified and litigation could not be prevented, approximately for what percent of the cases was the outcome in favor of your company?

Litigation outcome

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

D: DISSEMINATION OF TECHNOLOGICAL KNOWLEDGE

11. Can you say that information that can be found in patents held by your company is used as a source in R&D by rival companies?

Rival company source

- Never - Very Frequently

12. Do employees who have (at least some) share in the realization of patents search for information from patents or patent databases in (technical) research ?

Patent database search

- Never - Very Frequently

13. Patent support staff stimulates the use of patent information in technical research?

Support staff stimulation

- Never - Very Frequently

E: QUESTIONS CONCEIRNING FINANCIAL APPRECIATION

14. In comparison with other patents in your industry or technological field, how would you rate the economic value of your core patents?

Economic value

- Poor - Excellent

15. In comparison with other patents in your industry or technological field, How would rate the strategic value of your core patents?

Strategic value

- Poor - Excellent

16. When another company wants to acquire one of you patents, the value of your patents is calculated based on a similar and clear philosophy (e.g. based on similar patents that have been sold in the market)?

Procedures

- Never - Always

F: LIABILITY

17. In the last five years, what is approximately the percentage of infringement claims made on inventions developed in your company?

Infringement claims

%

18. In the last five years, what is approximately the percentage of inventions made in your company are put to use (and therefore become innovations)?

Innovations

%

19. In the last five years, approximately what percent of your patents was used to acquire a loan?

Loan acquirement

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%

G: THE USE OF PATENTS FOR PERFORMANCE INDICATION

20. When searching for a potential partner, is acquiring access to the technology of that partner the main motive?

Access technology

- Never - Always

21. When searching for a partner, is the identification of options and data retrieval done based on patent information?

option assessment

- Never - Always

22. When different options are assessed, is the patent portfolio the decisive factor in choosing a partnership?

Decision making

- Never - Always

H: STATEMENTS CONCERNING PATENT PORTFOLIO'S

23. In a patent or patent application, the claims define, in technical terms, the extent of the protection conferred by a patent, or the protection sought in a patent application. Can you agree that the average number of patent claims per patent is high in your company?

Patent claims

- Strongly Disagree - Strongly Agree

24. The inventions in your technology portfolio are unique, independent, and have less knowledge spillover (self-citations in patented inventions are high).

Patent citations

- Strongly Disagree - Strongly Agree

25. Patents citations used in your company's patents belong to a wide range of technological fields.

Technological fields

Strongly Disagree Strongly Agree

26. Your firm has built a diversified repertoire of technology portfolio in your primary technology category or in broadly defined technology categories.
Diversified portfolio

- Strongly Disagree - Strongly Agree

27. Do you have any remarks?
Remarks
You have completed the survey on patent management performance. Have you already filled in the questionnaire about patent
management maturity? If not, please remember to fill it in for the continuity of the study. Thank you very much for your participation!
Please press 'Done', and you can close the new window afterwards.
For additional information or questions about the survey or results please contact:
Dr. A.H. (Rik) van Reekum (a.h.vanreekum@utwente.nl)
Dexter Nijmanting (d.p.nijmanting@student.utwente.nl)
» Redirection to final page of Enquêtes Maken (wijzigen)

Appendix 2: Sample

Won member list

Industry

Abbott Healthcare Products BV	Fokker Aerostructures BV	Octrooibureau Van Der Lely NV
Agfa-Graphics NV	FrieslandCampina Innovation Centre	Philips International BV
Akzo Nobel NV	FujiFilm Manufacturing Europe BV	Picanol NV
Albemarle Catalysts BV	Hunter Douglas NV	Sabic
ASML Netherlands B.V.	Huntsman Europe BVBA	Shell International BV
Assa Abloy	IMEC	Sirris
Astellas Pharma Europe BV	Inalfa Roof Systems Group	SKF Research and Development Company
Avantium	KeyGene	Stamicarbon
Avebe Research & Development	Lankhorst Sneek BV	Synthon BV
Bejo Zaden	Marel stork poultry processing BV	Syral Belgium nv
Bekaert NV/SA	Meyn Food Processing Technology BV	Tata Steel
Boult Wade Tennant	MSD / Merck	TBG Europe NV
CNH Belgium NV	MTI Holland BV	Top Institute Food and Nutrition
Crucell Holland BV	Neopost Technologies BV	Unilever NV
D.E Master Blenders 1753	Niko Group NV	Vanderlande
Danone Research	Nuplex Resins BV	Wavin
Dorel B.V.	Nutreco International BV	WTCB
DSM	NXP Semiconductors	Zeepfabriek Dalli de Klok BV
Etex Group	Oce PPP Intellectual Property	

Independent search firms

First Line Patent Services	Magister Ltd.	Patentcheck ltd
HollandPatentSearch	NPS Patent Searches	Polyresearch Service BV
IP Tomas	OSIP Search & Watch	Vermeulen Patent & Intelligence
Jan Boersma	Patent Information Services	VZ Patent Intelligence

University

Bibliotheek Wageningen UR
Rijksuniversiteit Groningen
Servicedesk IP Wageningen UR

Independent agent

EP&C, Exter Polak & Charlois BV
Muller & Eilbracht BV
NLO
Octrooibureau Ferguson BV
Octrooibureau Vriesendorp & Gaade BV
Patentwerk BV
RightsDirect
RWS Group
V.O.

Provider

CAS-ACS International	LexisNexis Benelux	PatentSight GMBH
Cobidoc BV	LexisNexis/Univentio	Questel
Dialog Proquest	Lighthouse IP	Thomson Scientific
FIZ Karlsruhe / STN Europe	Minesoft	Treparel Information Solutions BV

Organization

European Patent Office
NL Octrooicentrum

Extraordinary membership

GO Opleidingen
Orde van Octrooigemachtigden
Platform Formalities Officers
V.O.

Appendix 3: Interview results

Multinational 1

This interview was conducted by telephone. This interview lasted about 45 minutes in which the content of both questionnaires was reviewed. It is important to mention that only the questionnaires were discussed, due to time constrictions it was not possible to review the theoretical part of this research. To be more specific, it was only possible to learn recommendations concerning the questions in the questionnaire. Below the recommendations for each questionnaire are discussed. These recommendations provide useful information for adaption the questionnaires for future research.

Maturity

Question 4: This question is difficult to understand. Furthermore, in large corporations it is impossible for employees to commercialize research results that fall outside the strategy of the company due to restrictions in their contracts. This is similar to universities were all (intellectual) exploits of employees belong to the employer. In large companies with extensive intellectual property departments the commercialization of research results only takes place in accordance with strategy and core business. The individual contract of employees define what is to be done with contributions by employees to intellectual property.

Question 5: Rewards for employees can be found for the most part in the inventive scheme. In this scheme the rewards for contributing in the realization of for example patents are described.

Questions 6: It was suggested to rephrase the question to: “Is the consideration to patent an invention a standard step in your innovation process?”.

Question 7: In the question the term ‘regular work meetings’ is mentioned. It should be more specific what is meant by this.

Question 8: It was suggested to rephrase the question to: “To what extent is the patentability of innovations results part of investment proposals?”. The use of the word ‘mandatory’ is not used correctly in this context.

Question 9: In the question the term ‘contracts’ is used. It should be more specific what is meant by this. For instance, there are sales and work related contracts. Furthermore, the answer to this question is always yes, due to the nature of the process. The only question is when there is collaboration with a third party in developing intellectual property the results of the endeavor are set.

Question 10: What is meant by ‘formally regulated’? You can mean internally or by law. When secrecy is internally regulated the question is what measures are taken into account in preventing leaking of trade secrets.
Question 11: In larger companies there is clearance required for publishing research results. Therefore the answer to this question for larger companies would always be ‘yes’.

Question 12: In the answer model the term ‘succeed’ is used. This is not the correct term in this context. A different set of answers is proposed to better check all the bases. One answer could be to do a risk analysis. From a risk analysis an action plan would emerge. Another answer could be to do a ‘clearance assessment’.

Question 13: The answer to this question would be confidential for most companies.

Question 14: The answer to this question would be confidential for most companies.

Question 15: In the question the terms ‘fighting and tracking’ is used. The correct term here would be ‘monitoring and enforcement of rights’.

Question 16: The spelling should be ‘pursue’. The answers provided to answer the question could be considered difficult. ‘No litigation’ could be changed into ‘never’. The consideration to pursue litigation is based on a cost/benefit analysis. Three considerations can be taken into account:

- If the other party should stop, will it actually have any effect?

- Is there a change to gain compensation for the damages caused?
- Is there significant damage to reputation?

Question 17: The answers to these questions should be:
- Deciding on which technological area to focus on
- To see if there is infringement from third parties
- To check patentability of research
- To find holes in a patent from others
- To do a patent analysis

Question 18: In the second answer patent is misspelled. The dissemination of patent information can be done through some form of a database:
- Internally
- Via subscription
- Via questions to patent attorneys or patent specialists.

A second way is through an invention that becomes a patent. When this happens there can be contact (e.g. through telephone) about the content of this patent.

Question 19: There are other ways to formulate the answer model that come closer to reality. So a different method to financially appreciate patents should be proposed.

Question 20: It is not necessary to explain the term FtO here. Furthermore there are a lot of different terms for an FtO research. The question here could also be if the company does an infringement assessment.

Question 21: The answer model here could possibly be too difficult to understand. It is suggested to simplify the answers.

Question 22: Translate the question to: “Do you use patents as collateral for a financial loan?”.

Question 24: It was noted that under normal circumstances there is a lot of communications concerning patents. This occurs when:
- During the whole process of new patent acquisition
- Through the patent portfolio
- To third parties via annual reports and publications

Question 25: The question is formulated in a difficult fashion, plus the spelling should be ‘taken into account’. It is suggested to change to question to: “What are the criteria for patent application?”. One possible answer should be the costs of applying.

Question 26: Answers ‘1 + 2’ say something about the frequency of evaluation while question ‘3 + 4’ are the base criteria that most companies use to evaluate a portfolio. The ideal situation would be to choose one cohesive answer model.

Question 27: Translate the question to: “Who typically takes the initiative for licensing? There could be several answers but it was suggested to us for example:
- Management
- License department
- Third parties

Question 29: The last part of the question should be ‘granted by your company’.

General remarks concerning maturity:
- In the description of part B, what is meant by technological renewal? A suggestion we be to use the term innovation.
- In the description of part F, concerning is misspelled.

Performance
Question 4: Remove the word 'approximately'.

Question 5: Looking from the point of view of a respondent it would be good to simplify the question. Furthermore change the term 'awarded' into 'granted'.

Question 8: Translate the question to "During the last five years, what is your judgment about the effectiveness of various mechanisms for protection against infringement?". Change the term 'secrecy' to 'trade secrets' in the answer model. Furthermore check what is meant by certification/normalization, t is not clear what this term adds to the answer model.

Question 9: Translate the question to "For what percentage of the cases was infringement resolved without litigation?

Question 13: Add to the question: 'by researchers'.

Question 16: Change the terms 'clear philosophy' to 'predetermined criteria' in the question.

Question 17: Change in the question the part 'made on inventions' to 'based on patents'. In the answer model a percentage is asked of the respondent. Given the probable low volume answers the percentage could be changed to the number of claims.

Question 18: Change the part in the question 'made in your company' to 'inventions that lead to product commercialization'.

Question 19: Add 'financial' to the term loan. There are many types of loans so it would be better to specify this.

Question 23: It is suggested here that the number of claims does not have to be that relevant. The power of each claim is more important here. Furthermore the term 'high' is used. To respondents this can be considered to be a too subjective measure. Maybe it can be replaced by a term that specifies to a greater extent what is meant by the question.

Question 24: The term 'high' is used. To respondents this can be considered to be a too subjective measure. Maybe it can be replaced by a term that specifies to a greater extent what is meant by the question.

Question 25: What is meant here is if a firm has a diversified portfolio or a focused one. It is suggested to use this distinction in more clear fashion.
General comments for both questionnaires:

- Improve on some of the specific terms that are used. Sometimes the spelling is not correct. Make sure the questions are short en powerful.
- Make sure that respondents know that it is a pilot study by a student, and not a study that is conducted by the university itself.
- Maybe these questionnaires are more suited for smaller companies who not have a complete understanding of their patent management system.

Multinational 2

This interview was conducted face-to-face in the IP&S department of this particular multinational. This interview lasted about an hour and forty-five minutes in which the content of the questionnaire about performance of patent management was reviewed. It is important to mention for a large portion of the interview one questionnaire was discussed, due to time constrictions it was not difficult to review the theoretical part of this research. Only minor theoretical implications were discussed. Below, the content of the interview is discussed. The recommendations from this interview provide useful information for adaption the questionnaires for future research.

Introduction

It is important to note that the interviewee stressed the enormous size of the company's R&D. Currently there are working more than 1.500 employees in the research field. Over a typical year, for more than 1.500 inventions a patent application is filed, resulting in more than one patent per scientist per year filed. The patent portfolio constitutes of over 54.000 patents, of which about 15.000 patents are the result of own inventions. The respondent stressed the importance of this information to fully appreciate the scale of the company's R&D efforts, and important in this study, the management of patents. This company has such a large patent portfolio that it is difficult to measure for example the contribution of employees to one specific topic. This is reflected in the comments on the performance questionnaire that is discussed below.

Performance:

Question 1: Here come the scale issues into play. The company has such a large number of people involved in R&D that is it difficult to relate this question to specific percentages. Also because researchers typically do not move further with the project their involved in. For project were this is the case it would be possible to measure the percentage involved in commercialization. But as a whole it is difficult to put a label on it.

Question 2: Same as question 1. Although it was mentioned that probably all employees involved in the realization of patents are aware of the policy related to inventions made. It was explained that within the company a portal exists were information can be found on IP management. In relation to question 1, it is important to stress that before innovations become main stream and licensing programs are set up often 5-10 years go by. Making it even more difficult to link employees to the commercialization of research results.

Question 3: According to the interviewee, there is hardly any financial incentive for employees that are involved in the realization of patents. Within the company it viewed that contribution to patents is just part of the job description. People just get paid based on how well they perform at their job. Salaries are high enough, but there is a small compensation for those who help realize patents.

Question 4: Process and product innovations are very broad terms. It is difficult to answer this question because of the high diversity in innovations. Furthermore, a lot of innovations are in the manufacturing process. A lot of these innovations do not lead to patents. That being said, when the decision is made to patent, and an application is always filed.

Question 5: A lot of careful consideration is placed in the patent application. This means that a patent application is always almost granted when an application is made. To make this question easier to answer, it could be: "how many from the applications over the last 5 year have led to patents now?".

Question 6: Beware that there is a lot of diversity in licensing contracts. The type of contract depends on the business model. Example: In the bio-pharmaceutical industry there are a lot of start-ups that include licensing in their business model. The company also had different models for licensing. But note that exclusiveness can also be a goal for a company, in this respect performance does not lie in the licensing contracts. Furthermore, licensing can also be a result of coercion from the law, or cooperation to form cross-licenses (e.g. medical semi-conductor industry).

Question 7: According to the interviewee it is not clear whether publications say something about performance.

Question 9: Interesting question. It is however difficult to answer because of the scale. It would take a lot of research to determine this for such a large company. Sometimes it is knowingly ignored. Large players in the market often know their costumers and have a cease-fire with their competitors because of the large stakes and great costs involved with litigation.

Question 10:Larger companies will only engage litigation when the outcome is almost certain in favor of the company. This does not however mean that the cases are always won, but because careful consideration is put in the decision to litigate it is most likely that the percentage of this question is answered high.

Question 11: This would be very interesting to know, but difficult to find out. You could flip the question and ask the following": How often do employees look in patent databases to find information in patents belonging to competitors?".

Question 12: Same as question 11.
Question 13: a better question to ask here would be: "Do you have in your company people who are actively work on the patent portfolio?". An example could be specialists on IP. Perhaps a follow-up question could be to ask how many people this includes.

Question 14: Due to new legislation you cannot put own inventions on the balance sheet.

Question 15: If you look at the strategic reference in the question you could specify what is meant by this. A way to rephrase this question would be: "How does a company use its patent portfolio?". Three answers could be: defensively, exclusiveness (e.g. model rights) and to generate money (licenses).

Question 16: When explained the question seems relevant. So the question could be formulated somewhat clearer. The same goes for the answer model. Furthermore only a part of the patent portfolio is actively looked at. Patents that are not part of the important groups are often overlooked.

Question 17: This can be considered to be confidential information.

Question 18: A better way to formulate this question would be: "What part (percentage) of the inventions lead to an actual patent?". A big help in the process would be to capture and identify inventions made in the company. This would be a great help in making the decision to patent or not.

Question 19:For large companies this is not so relevant. There are however some follow-up questions here that could potentially be very interesting. The first could be: "Is the IP portfolio used as collateral for a financial loan?". The second could be: "Is the IP portfolio used as collateral for attracting investors (capital)?".

Question 23: Important to note here is that there are different claim categories. Furthermore there are preconditions to a patent application (number of pages etc.) Also some type of claims have to be in the application, and there is a limitation to the number of claims. If you exceed this limited extra fees have to be paid. So companies will have the maximum claims without paying extra costs.

Question 24: Instead of inventions, ask here about patents. An extra question could be here: "Before applying for a patent, is there an analysis made about the patentability?". This can be done externally by experts. But also internally, by checking own databases.

Question 25: You can use citations check how early you are in a technological field. If there are a lot of citations then you are probably very late. The difficulty here is that as a company, you have to do it with the expertise you have. If you a late in the market It can be very difficult to improve.

Question 26: If you have a small technological base as a company it can be difficult to be competitive and grow to a diversified portfolio.

General comments
After the interview three topics were discussed that could be worthwhile for future research and that connect with this research.

- An important question that could be relevant is: "How is IP bedded in the organization?". The main focus then would be to identify who is responsible for IP management in the organization. So are there individuals, groups, departments actively involved in IP management. The term 'actively' is important here since many organizations have people appointed for IP management but these people at not actively involved. Other questions related to this topic could be: " How many employees work in R&D?" and "What is the size and composition of the IP portfolio?".
- Check what the financial structure is relating to IP. Companies have different business models with different financial appreciation. One of the questions in the survey related to the appreciation of patents, it would be interesting how firms actually appreciate patents.

- An important recommendation for future research would be to check the company wide entanglement of IP management. Patents are important, but they have important connections with other forms of IP such as brand rights. Example: The patent for aspirin expired years ago, but, through a strong brand name companies can still be ahead of competitors.

Appendix 4: Descriptive results

Frequency tables maturity items

Commercialization maturity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Resentful	5	25,0	27,8	27,8
	It is allowed, but not stimulated	12	60,0	66,7	94,4
	It is supported, but the initiative lies with the employee	1	5,0	5,6	100,0
	Total	18	90,0	100,0	
Missing	-99	2	10,0		
Total		20	100,0		

Employee rewards

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	9	45,0	45,0	45,0
	Yes, immaterial rewards	1	5,0	5,0	50,0
	Yes, fixed material or variable material rewards	7	35,0	35,0	85,0
	Yes, fixed material and variable material rewards	3	15,0	15,0	100,0
	Total	20	100,0	100,0	

Patent initiative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	From a manager and/or researchers	7	35,0	35,0	35,0
	From a patent attorney and/or managers and/or researchers	13	65,0	65,0	100,0
	Total	20	100,0	100,0	

Patent work meetings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No, it is not a part of regular work meetings	3	15,0	15,0	15,0
	Yes, the same, but also before the invention is realized	2	10,0	10,0	25,0
	Yes, the same, including researchers	15	75,0	75,0	100,0
	Total	20	100,0	100,0	

Patentability research proposal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not mandatory	2	10,0	10,0	10,0
	Not mandatory, but it is appreciated	11	55,0	55,0	65,0
	Mandatory	6	30,0	30,0	95,0
	Mandatory, including a preview on exploitation	1	5,0	5,0	100,0
	Total	20	100,0	100,0	

IP defined in contracts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not defined in contracts	3	15,0	15,0	15,0
	It is defined, but it differs per case, and there is no consult needed within the organization	2	10,0	10,0	25,0
	It is defined, standard contracts are used in consultation with other stakeholders/experts	8	40,0	40,0	65,0
	The same, whereby compliance with contractual agreements is checked	7	35,0	35,0	100,0

	Total	20	100,0	100,0	

Secrecy regulation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It is a standard part of the labor contract of employees	5	25,0	25,0	25,0
	The same, but it is also part of the contracts of external capacity (e.g. post-docs)	10	50,0	50,0	75,0
	The same, whereby all employees are actually informed of these rules	5	25,0	25,0	100,0
	Total	20	100,0	100,0	

Publication regulation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	There are no regulations, nobody is responsible for supervising this	1	5,0	5,3	5,3
	The same, but agreements for release are based on a case to case basis	6	30,0	31,6	36,8
	There are different regulations whereby a manager is formally responsible for release/authorization	3	15,0	15,8	52,6
	The same, whereby researchers are actually informed of these regulations	9	45,0	47,4	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Infringement prevention

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	To follow potential warnings from competitors	2	10,0	10,5	10,5
	To follow potential warnings from competitors, and send out warnings yourself	9	45,0	47,4	57,9
	Pre-emptive offering/asking (cross) licenses	8	40,0	42,1	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Infringement made

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	9	45,0	47,4	47,4
	Yes	10	50,0	52,6	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Infringement suffered

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	5	25,0	25,0	25,0
	Yes	15	75,0	75,0	100,0
	Total	20	100,0	100,0	

Fighting infringement regulation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not formally organized, differs on a case by case basis	3	15,0	15,0	15,0
	It is completely outsourced	1	5,0	5,0	20,0

	Due to limited internal capacity, it is complemented for an important part with external expertise	4	20,0	20,0	40,0
	It is conducted largely by internal capacity, whereby external expertise can be acquired for specific inquiries	12	60,0	60,0	100,0
	Total	20	100,0	100,0	

Litigation decision

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No litigation	2	10,0	11,1	11,1
	Only when the economic effects of infringement are felt	4	20,0	22,2	33,3
	In principle always when infringement is detected	6	30,0	33,3	66,7
	Only when no other option is available	6	30,0	33,3	100,0
	Total	18	90,0	100,0	
Missing	-99	2	10,0		
Total		20	100,0		

Patent information use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	For patent applications, but also as input for ideas and/or own specific research	3	15,0	15,0	15,0
	The same, but also to gain insight in the strategy of competitors	17	85,0	85,0	100,0
	Total	20	100,0	100,0	

Dissemination patent information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Patent information is available from a central point and use is based on own initiative	4	20,0	20,0	20,0
	Information is structurally provided by an assigned person but on his or her own initiative	3	15,0	15,0	35,0
	Information is structurally provided by an assigned person but also on initiative of the researcher	13	65,0	65,0	100,0
	Total	20	100,0	100,0	

Patent appreciation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No financial appreciation	11	55,0	57,9	57,9
	Patents are valued based on manufacturing or purchasing costs	1	5,0	5,3	63,2
	For external accounting based on costs and for internal reports based on cost price plus a standard profit margin	2	10,0	10,5	73,7
	For external accounting based on costs and for internal reports based on expected return c.q. market potential	5	25,0	26,3	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Freedom to operate analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	An analysis is conducted after infringement is claimed to prevent future litigation	1	5,0	5,3	5,3
	An analysis is done. When (possible) infringement is found the problem is circumvented or the project canceled	1	5,0	5,3	10,5
	The same. When (possible) infringement is found, circumvention is an option, as well as acquiring a license or patent	17	85,0	89,5	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Effort technology development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	R&D in new products is avoided. The organizations efforts are aimed at improving and evolving the proven products	1	5,0	5,0	5,0
	Alternatives assessed before investing	1	5,0	5,0	10,0
	Initial (R&D) costs are seen as investments. The development of new products is done according the product life-cycle	18	90,0	90,0	100,0
	Total	20	100,0	100,0	

Patent loan collateral

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Does not use patents as collateral to obtain a loan	13	65,0	65,0	65,0
	The patent (portfolio) is valuated, but is not used as collateral	5	25,0	25,0	90,0
	On request of a financier a patent is used to obtain a loan	1	5,0	5,0	95,0
	The organization uses patents to obtain a loan	1	5,0	5,0	100,0
	Total	20	100,0	100,0	

Portfolio partner evaluation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not taken into account in evaluation	4	20,0	21,1	21,1
	Low priority in evaluation	8	40,0	42,1	63,2
	High priority in evaluation	6	30,0	31,6	94,7
	Highest priority in evaluation	1	5,0	5,3	100,0
	Total	19	95,0	100,0	
Missing	System	1	5,0		
Total		20	100,0		

Patent communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	7	35,0	36,8	36,8
	Only external after the patent is granted	1	5,0	5,3	42,1
	The same, but also internally	11	55,0	57,9	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Portfolio composition patent application

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all, the patent application procedure is started when patentability is feasible	7	35,0	35,0	35,0
	If there is a technological connection	4	20,0	20,0	55,0
	If there is a technological connection as well as a commercial connection	8	40,0	40,0	95,0
	Based on audits, research proposals are provided with patent paragraphs	1	5,0	5,0	100,0
	Total	20	100,0	100,0	

Portfolio evaluation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	There is no evaluation	1	5,0	5,0	5,0
	Based on costs	3	15,0	15,0	20,0
	Patents are evaluated based on financial potential/return	1	5,0	5,0	25,0
	Patents are evaluated based on financial potential/return and strategic importance	15	75,0	75,0	100,0
	Total	20	100,0	100,0	

Licensing initiative

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No one, there are no licensing activities	2	10,0	11,1	11,1
	From third parties	1	5,0	5,6	16,7
	From third parties and management	10	50,0	55,6	72,2

	From third parties, management and researchers	5	25,0	27,8	100,0
	Total	18	90,0	100,0	
Missing	-99	2	10,0		
Total		20	100,0		

Third party licenses granted

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	4	20,0	21,1	21,1
	Less than 5	11	55,0	57,9	78,9
	Between 5 and 20	3	15,0	15,8	94,7
	More than 20	1	5,0	5,3	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Company licenses granted

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	6	30,0	31,6	31,6
	Less than 5	6	30,0	31,6	63,2
	Between 5 and 20	3	15,0	15,8	78,9
	More than 20	4	20,0	21,1	100,0
	Total	19	95,0	100,0	
Missing	-99	1	5,0		
Total		20	100,0		

Frequency tables performance items

Commercialization performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	8	47,1	50,0	50,0
	21-40%	3	17,6	18,8	68,8
	41-60%	1	5,9	6,3	75,0
	61-80%	3	17,6	18,8	93,8

	81-100%	1	5,9	6,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Policy awareness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	2	11,8	11,8	11,8
	21-40%	1	5,9	5,9	17,6
	41-60%	2	11,8	11,8	29,4
	61-80%	3	17,6	17,6	47,1
	81-100%	9	52,9	52,9	100,0
	Total	17	100,0	100,0	

Compensation awareness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	3	17,6	17,6	17,6
	41-60%	1	5,9	5,9	23,5
	61-80%	4	23,5	23,5	47,1
	81-100%	9	52,9	52,9	100,0
	Total	17	100,0	100,0	

Application performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	2	11,8	11,8	11,8
	21-40%	2	11,8	11,8	23,5
	41-60%	7	41,2	41,2	64,7
	61-80%	2	11,8	11,8	76,5
	81-100%	4	23,5	23,5	100,0
	Total	17	100,0	100,0	

Patents awarded

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	1	5,9	6,3	6,3
	41-60%	2	11,8	12,5	18,8
	61-80%	8	47,1	50,0	68,8
	81-100%	5	29,4	31,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Licensing contracts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	7	41,2	43,8	43,8
	1	1	5,9	6,3	50,0
	5	1	5,9	6,3	56,3
	10	1	5,9	6,3	62,5
	20	3	17,6	18,8	81,3
	50	1	5,9	6,3	87,5
	60	1	5,9	6,3	93,8
	90	1	5,9	6,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Publication results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	17,6	20,0	20,0
	2	1	5,9	6,7	26,7
	5	3	17,6	20,0	46,7
	10	1	5,9	6,7	53,3
	25	3	17,6	20,0	73,3
	40	1	5,9	6,7	80,0
	50	2	11,8	13,3	93,3
	100	1	5,9	6,7	100,0

	Total	15	88,2	100,0	
Missing	-99	2	11,8		
Total		17	100,0		

Time lead on competitors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Modest	3	17,6	18,8	18,8
	Moderate	3	17,6	18,8	37,5
	Very important	10	58,8	62,5	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Keeping qualified people in the firm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Insignificant	1	5,9	6,3	6,3
	Modest	7	41,2	43,8	50,0
	Moderate	2	11,8	12,5	62,5
	Very important	3	17,6	18,8	81,3
	Crucial	3	17,6	18,8	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Secrecy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Insignificant	1	5,9	6,3	6,3
	Modest	2	11,8	12,5	18,8
	Very important	10	58,8	62,5	81,3
	Crucial	3	17,6	18,8	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Patent protection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Modest	2	11,8	12,5	12,5
	Moderate	2	11,8	12,5	25,0
	Very important	10	58,8	62,5	87,5
	Crucial	2	11,8	12,5	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Complexity of product or process design

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Insignificant	1	5,9	6,3	6,3
	Modest	1	5,9	6,3	12,5
	Moderate	5	29,4	31,3	43,8
	Very important	9	52,9	56,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Copyright and related laws

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Insignificant	2	11,8	12,5	12,5
	Modest	4	23,5	25,0	37,5
	Moderate	7	41,2	43,8	81,3
	Very important	3	17,6	18,8	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Certification, normalization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Insignificant	4	23,5	25,0	25,0
	Modest	3	17,6	18,8	43,8
	Moderate	8	47,1	50,0	93,8
	Very important	1	5,9	6,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Litigation prevention

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	2	11,8	14,3	14,3
	21-40%	2	11,8	14,3	28,6
	41-60%	1	5,9	7,1	35,7
	61-80%	2	11,8	14,3	50,0
	81-100%	7	41,2	50,0	100,0
	Total	14	82,4	100,0	
Missing	-99	3	17,6		
Total		17	100,0		

Litigation outcome

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	41-60%	2	11,8	18,2	18,2
	61-80%	2	11,8	18,2	36,4
	81-100%	7	41,2	63,6	100,0
	Total	11	64,7	100,0	
Missing	-99	6	35,3		
Total		17	100,0		

Rival company source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	5,9	6,7	6,7

	Occasionally	8	47,1	53,3	60,0
	Frequently	5	29,4	33,3	93,3
	Very frequently	1	5,9	6,7	100,0
	Total	15	88,2	100,0	
Missing	-99	2	11,8		
Total		17	100,0		

Patent database search

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rarely	3	17,6	17,6	17,6
	Occasionally	8	47,1	47,1	64,7
	Frequently	5	29,4	29,4	94,1
	Very frequently	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Support staff stimulation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Occasionally	1	5,9	5,9	5,9
	Frequently	11	64,7	64,7	70,6
	Very frequently	5	29,4	29,4	100,0
	Total	17	100,0	100,0	

Economic value

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	5,9	5,9	5,9
	Average	3	17,6	17,6	23,5
	Good	9	52,9	52,9	76,5
	Excellent	4	23,5	23,5	100,0
	Total	17	100,0	100,0	

Strategic value

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	5,9	5,9	5,9
	Average	7	41,2	41,2	47,1
	Good	6	35,3	35,3	82,4
	Excellent	3	17,6	17,6	100,0
	Total	17	100,0	100,0	

Patent value philosophy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	17,6	18,8	18,8
	Rarely	1	5,9	6,3	25,0
	Sometimes	10	58,8	62,5	87,5
	Often	2	11,8	12,5	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Infringement claims

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3	17,6	21,4	21,4
	1	1	5,9	7,1	28,6
	2	3	17,6	21,4	50,0
	5	4	23,5	28,6	78,6
	8	1	5,9	7,1	85,7
	10	1	5,9	7,1	92,9
	20	1	5,9	7,1	100,0
	Total	14	82,4	100,0	
Missing	-99	3	17,6		
Total		17	100,0		

Inventions to innovations

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	30	1	5,9	6,3	6,3
	40	1	5,9	6,3	12,5
	50	1	5,9	6,3	18,8
	60	1	5,9	6,3	25,0
	70	5	29,4	31,3	56,3
	75	1	5,9	6,3	62,5
	80	5	29,4	31,3	93,8
	90	1	5,9	6,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Loan acquirement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20%	15	88,2	93,8	93,8
	81-100%	1	5,9	6,3	100,0
	Total	16	94,1	100,0	
Missing	-99	1	5,9		
Total		17	100,0		

Partner technology access

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	11,8	11,8	11,8
	Rarely	1	5,9	5,9	17,6
	Sometimes	4	23,5	23,5	41,2
	Often	9	52,9	52,9	94,1
	Always	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Partner option assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	5,9	5,9	5,9

	Rarely	5	29,4	29,4	35,3
	Sometimes	9	52,9	52,9	88,2
	Often	1	5,9	5,9	94,1
	Always	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Partner portfolio selection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	17,6	17,6	17,6
	Rarely	6	35,3	35,3	52,9
	Sometimes	8	47,1	47,1	100,0
	Total	17	100,0	100,0	

Patent claims

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	17,6	17,6	17,6
	Disagree	3	17,6	17,6	35,3
	Neither agree nor disagree	10	58,8	58,8	94,1
	Strongly agree	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Portfolio uniqueness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	5,9	5,9	5,9
	Disagree	3	17,6	17,6	23,5
	Neither agree nor disagree	9	52,9	52,9	76,5
	Agree	3	17,6	17,6	94,1
	Strongly agree	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Technical range citations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	11,8	11,8	11,8
	Disagree	3	17,6	17,6	29,4
	Neither agree nor disagree	9	52,9	52,9	82,4
	Agree	2	11,8	11,8	94,1
	Strongly agree	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Portfolio diversification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	5,9	5,9	5,9
	Disagree	2	11,8	11,8	17,6
	Neither agree nor disagree	5	29,4	29,4	47,1
	Agree	8	47,1	47,1	94,1
	Strongly agree	1	5,9	5,9	100,0
	Total	17	100,0	100,0	

Mean tables maturity functions

Descriptive Statistics

	N	Mean
Incentive maturity	20	2,0000
Appropriation maturity	20	3,0667
Protection maturity	20	3,1917
Dissemination maturity	20	3,6500
Appreciation maturity	19	2,0526
Liability maturity	20	3,0417
Indication maturity	20	2,5250
Portfolio maturity	20	2,5992
Valid N (list wise)	19	

Mean statistics performance functions

Descriptive Statistics

	N	Mean
Incentive performance	17	3,3529
Appropriation performance	17	3,6471

Protection performance	16	3,8542
Dissemination performance	17	3,6078
Appreciation performance	17	3,3922
Liability performance	16	1,2500
Indication performance	17	2,8039
Portfolio performance	17	2,9412
Valid N (list wise)	15	

Company size crosstabs maturity

Incentive attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Incentive attitude	Inactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
	Reactive	Count	0	0	1
		% of Total	0,0%	0,0%	5,0%
	Active	Count	0	2	1
		% of Total	0,0%	10,0%	5,0%
	Proactive	Count	1	0	0
		% of Total	5,0%	0,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Incentive attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Incentive attitude	Inactive	Count	4	5
		% of Total	20,0%	25,0%
	Reactive	Count	5	6
		% of Total	25,0%	30,0%
	Active	Count	5	8
		% of Total	25,0%	40,0%
	Proactive	Count	0	1
		% of Total	0,0%	5,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Appropriation attitude * Employee count Cross tabulation

	Employee count

			Between 5 and 20	Between 50 and 200	Between 200 and 500
Appropriation attitude	Reactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
	Active	Count	1	1	2
		% of Total	5,0%	5,0%	10,0%
	Proactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Appropriation attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Appropriation attitude	Reactive	Count	1	2
		% of Total	5,0%	10,0%
	Active	Count	10	14
		% of Total	50,0%	70,0%
	Proactive	Count	3	4
		% of Total	15,0%	20,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Protection attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Protection attitude	Inactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
	Reactive	Count	0	0	1
		% of Total	0,0%	0,0%	5,0%
	Active	Count	0	2	1
		% of Total	0,0%	10,0%	5,0%
	Proactive	Count	1	0	0
		% of Total	5,0%	0,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Protection attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Protection attitude	Inactive	Count	0	1
		% of Total	0,0%	5,0%
	Reactive	Count	1	2
		% of Total	5,0%	10,0%
	Active	Count	6	9
		% of Total	30,0%	45,0%
	Proactive	Count	7	8
		% of Total	35,0%	40,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Dissemination attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Dissemination attitude	Active	Count	1	0	1
		% of Total	5,0%	0,0%	5,0%
	Proactive	Count	0	3	1
		% of Total	0,0%	15,0%	5,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Dissemination attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Dissemination attitude	Active	Count	2	4
		% of Total	10,0%	20,0%
	Proactive	Count	12	16
		% of Total	60,0%	80,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Asset attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Asset attitude	Inactive	Count	1	1	2

		% of Total	5,3%	5,3%	10,5%
	Reactive	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Active	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Proactive	Count	0	2	0
		% of Total	0,0%	10,5%	0,0%
Total		Count	1	3	2
		% of Total	5,3%	15,8%	10,5%

Asset attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Asset attitude	Inactive	Count	7	11
		% of Total	36,8%	57,9%
	Reactive	Count	1	1
		% of Total	5,3%	5,3%
	Active	Count	2	2
		% of Total	10,5%	10,5%
	Proactive	Count	3	5
		% of Total	15,8%	26,3%
Total		Count	13	19
		% of Total	68,4%	100,0%

Liability attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Liability attitude	Reactive	Count	1	0	0
		% of Total	5,0%	0,0%	0,0%
	Active	Count	0	2	2
		% of Total	0,0%	10,0%	10,0%
	Proactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Liability attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Liability attitude	Reactive	Count	1	2
		% of Total	5,0%	10,0%
	Active	Count	12	16
		% of Total	60,0%	80,0%
	Proactive	Count	1	2
		% of Total	5,0%	10,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Indication attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Indication attitude	Inactive	Count	0	1	1
		% of Total	0,0%	5,0%	5,0%
	Reactive	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
	Active	Count	0	0	1
		% of Total	0,0%	0,0%	5,0%
	Proactive	Count	1	1	0
		% of Total	5,0%	5,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Indication attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Indication attitude	Inactive	Count	1	3
		% of Total	5,0%	15,0%
	Reactive	Count	5	6
		% of Total	25,0%	30,0%
	Active	Count	4	5
		% of Total	20,0%	25,0%
	Proactive	Count	4	6
		% of Total	20,0%	30,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Portfolio attitude * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Portfolio attitude	Inactive	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Reactive	Count	0	0	1
		% of Total	0,0%	0,0%	5,0%
	Active	Count	1	2	1
		% of Total	5,0%	10,0%	5,0%
	Proactive	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	11	Count	0	1	0
		% of Total	0,0%	5,0%	0,0%
Total		Count	1	3	2
		% of Total	5,0%	15,0%	10,0%

Portfolio attitude * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Portfolio attitude	Inactive	Count	1	1
		% of Total	5,0%	5,0%
	Reactive	Count	5	6
		% of Total	25,0%	30,0%
	Active	Count	7	11
		% of Total	35,0%	55,0%
	Proactive	Count	1	1
		% of Total	5,0%	5,0%
	11	Count	0	1
		% of Total	0,0%	5,0%
Total		Count	14	20
		% of Total	70,0%	100,0%

Company size crosstabs performance

Incentive performance * Employee count Cross tabulation

	Employee count

			Between 5 and 20	Between 50 and 200	Between 200 and 500
Incentive performance	Poor	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Fair	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Average	Count	1	1	0
		% of Total	5,9%	5,9%	0,0%
	Good	Count	0	1	2
		% of Total	0,0%	5,9%	11,8%
	Excellent	Count	0	1	0
		% of Total	0,0%	5,9%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Incentive performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Incentive performance	Poor	Count	1	1
		% of Total	5,9%	5,9%
	Fair	Count	2	2
		% of Total	11,8%	11,8%
	Average	Count	3	5
		% of Total	17,6%	29,4%
	Good	Count	4	7
		% of Total	23,5%	41,2%
	Excellent	Count	1	2
		% of Total	5,9%	11,8%
Total		Count	11	17
		% of Total	64,7%	100,0%

Appropriation performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Appropriation performance	Poor	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Average	Count	1	0	0
		% of Total	5,9%	0,0%	0,0%

	Good	Count	0	2	2
		% of Total	0,0%	11,8%	11,8%
	Excellent	Count	0	1	0
		% of Total	0,0%	5,9%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Appropriation performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Appropriation performance	Poor	Count	1	1
		% of Total	5,9%	5,9%
	Average	Count	2	3
		% of Total	11,8%	17,6%
	Good	Count	6	10
		% of Total	35,3%	58,8%
	Excellent	Count	2	3
		% of Total	11,8%	17,6%
Total		Count	11	17
		% of Total	64,7%	100,0%

Protection performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Protection performance	Fair	Count	0	1	0
		% of Total	0,0%	6,3%	0,0%
	Average	Count	1	0	0
		% of Total	6,3%	0,0%	0,0%
	Good	Count	0	2	0
		% of Total	0,0%	12,5%	0,0%
	Excellent	Count	0	0	2
		% of Total	0,0%	0,0%	12,5%
Total		Count	1	3	2
		% of Total	6,3%	18,8%	12,5%

Protection performance * Employee count Cross tabulation

	Employee count	
	More than 500	Total

Protection performance	Fair	Count	0	1
		% of Total	0,0%	6,3%
	Average	Count	3	4
		% of Total	18,8%	25,0%
	Good	Count	4	6
		% of Total	25,0%	37,5%
	Excellent	Count	3	5
		% of Total	18,8%	31,3%
Total		Count	10	16
		% of Total	62,5%	100,0%

Dissemination performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Dissemination performance	Average	Count	0	1	2
		% of Total	0,0%	5,9%	11,8%
	Good	Count	1	2	0
		% of Total	5,9%	11,8%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Dissemination performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Dissemination performance	Average	Count	4	7
		% of Total	23,5%	41,2%
	Good	Count	7	10
		% of Total	41,2%	58,8%
Total		Count	11	17
		% of Total	64,7%	100,0%

Asset Performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Asset Performance	Poor	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Average	Count	0	3	2

		% of Total	0,0%	17,6%	11,8%
	Good	Count	1	0	0
		% of Total	5,9%	0,0%	0,0%
	Excellent	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Asset Performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Asset Performance	Poor	Count	1	1
		% of Total	5,9%	5,9%
	Average	Count	3	8
		% of Total	17,6%	47,1%
	Good	Count	6	7
		% of Total	35,3%	41,2%
	Excellent	Count	1	1
		% of Total	5,9%	5,9%
Total		Count	11	17
		% of Total	64,7%	100,0%

Liability performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Liability performance	Poor	Count	1	2	2
		% of Total	6,3%	12,5%	12,5%
	Excellent	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
Total		Count	1	2	2
		% of Total	6,3%	12,5%	12,5%

Liability performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Liability performance	Poor	Count	10	15
		% of Total	62,5%	93,8%
	Excellent	Count	1	1

	% of Total	6,3%	6,3%
Total	Count	11	16
	% of Total	68,8%	100,0%

Indication performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Indication performance	Poor	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
	Fair	Count	0	3	0
		% of Total	0,0%	17,6%	0,0%
	Average	Count	1	0	2
		% of Total	5,9%	0,0%	11,8%
	Good	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Indication performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Indication performance	Poor	Count	1	1
		% of Total	5,9%	5,9%
	Fair	Count	2	5
		% of Total	11,8%	29,4%
	Average	Count	6	9
		% of Total	35,3%	52,9%
	Good	Count	2	2
		% of Total	11,8%	11,8%
Total		Count	11	17
		% of Total	64,7%	100,0%

Portfolio performance * Employee count Cross tabulation

			Employee count		
			Between 5 and 20	Between 50 and 200	Between 200 and 500
Portfolio performance	Poor	Count	0	0	0
		% of Total	0,0%	0,0%	0,0%

	Average	Count	1	1	2
		% of Total	5,9%	5,9%	11,8%
	Good	Count	0	2	0
		% of Total	0,0%	11,8%	0,0%
Total		Count	1	3	2
		% of Total	5,9%	17,6%	11,8%

Portfolio performance * Employee count Cross tabulation

			Employee count	
			More than 500	Total
Portfolio performance	Poor	Count	1	1
		% of Total	5,9%	5,9%
	Average	Count	8	12
		% of Total	47,1%	70,6%
	Good	Count	2	4
		% of Total	11,8%	23,5%
Total		Count	11	17
		% of Total	64,7%	100,0%

Appendix 5: Reliability

Scores on maturity functions

Scale: Appropriation maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,684	,695	6

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Patent initiative	,678
Patent work meetings	,740
Patentability research proposal	,602
IP defined in contracts	,622
Secrecy regulation	,660
Publication regulation	,506

Scale: Protection maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,507	,469	4

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Infringement prevention	,541
Infringement made	,506
Fighting infringement regulation	,242
Litigation decision	,307

Scale: Dissemination maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
-,541	-,806	2

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Patent information use	.
Dissemination patent information	.

Scale: Liability maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,146	,139	3

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Freedom to operate analysis	,129
Effort technology development	,286
Patent loan collateral	-,203[a]

Scale: Performance indication maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,485	,535	2

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Portfolio partner evaluation	.
Patent communication	.

Scale: Portfolio maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,797	,807	5

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Company licenses granted	,744
Third party licenses granted	,726
Licensing initiative	,695
Portfolio evaluation	,842
Portfolio composition patent application	,766

Scale: Incentive maturity

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,561	,684	2

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Commercialization maturity	.
Employee rewards	.

Scores on performance functions

Scale: Incentive

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,528	,527	3

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Commercialization performance	,583
Policy awareness	,231

Compensation awareness	,423

Scale: Appropriation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,521	,528	2

Scale: Protection

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,635	,737	9

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Patent protection	,569
Litigation prevention	,679
Litigation outcome	,586
Time lead on competitors	,622
Keeping qualified people in the firm	,704
Secrecy	,518
Complexity of product or process design	,581
Copyright and related laws	,596
Certification, normalization	,581

Scale: Dissemination

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
-,084	,128	3

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Rival company source	,843

Patent database search	-,682[a]
Support staff stimulation	-1,100[a]

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codlings.

Scale: Financial appreciation

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,739	,735	3

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Economic value	,520
Strategic value	,497
Patent value philosophy	,862

Scale: Performance indication

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,823	,838	3

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Partner technology access	,777
Partner option assessment	,771
Partner portfolio selection	,727

Scale: Portfolio

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items

,475	,480	4

Item-Total Statistics

	Cronbach's Alpha if Item Deleted
Patent claims	,454
Portfolio uniqueness	,309
Technical range citations	,554
Portfolio diversification	,255

Appendix 6: Revised performance questionnaire

IP Management level questions

A: INCENTIVES FOR TECHNOLOGICAL RENEWAL

1. Approximately what percentage of your employees contributes to the commercialization of intellectual property?

2. What portals does your company have were IP information is made available for employees?

3. Does the compensation structure for employees lead to higher R&D output?

B: APPROPRIATION OF TECHNOLOGICAL KNOWLEDGE

4. In the last five years, approximately a patent application was filed for approximately what percentage of your company's product and process innovations?

5. How many from the applications over the last 5 year have led to patents now?

6. In the last 5 years, what has been the main motivation for licensing?

C: THE PROTECTION OF INTELLECTUAL PROPERTY

7. During the last five years, effective is your patent protection?

8. In the last five years, how effective is tracking and preventing litigation?

9. If litigation could not be prevented, approximately for what percent of the cases was the outcome in favor of your company?

D: DISSEMINATION OF TECHNOLOGICAL KNOWLEDGE

10. How often do employees look in patent databases to find information in patents belonging to competitors?

11. How often do competitors look in patent databases to find information in patents belonging to your company?

12. Do you have in your company people who are actively work on the patent portfolio?

E: QUESTIONS CONCEIRNING FINANCIAL APPRECIATION

13. In comparison with other patents in your industry or technological field, how would you rate the economic value of your core patents?

14. In comparison with other patents in your industry or technological field, How would rate the strategic value of your core patents?

15. When another company wants to acquire one of you patents, the value of your patents is calculated based on a similar and clear philosophy (e.g. based on similar patents that have been sold in the market)?

F: LIABILITY

16. In the last five years, how would you rate the effectiveness of the prevention of infringement claims made on inventions developed in your company?

17. What part (percentage) of the inventions lead to an actual patent.

G: THE USE OF PATENTS FOR PERFORMANCE INDICATION

18. When searching for a potential partner, is acquiring access to the technology of that partner the main motive?

19. Is the IP portfolio used as collateral for attracting investors (capital)?

H: STATEMENTS CONCERNING PATENT PORTFOLIO'S

20. Do the patents in your portfolio belong to a wide range of technological fields?

21. Would you say your firm has a diversified or a focused patent portfolio?

IP worker level questions

A: INCENTIVES FOR TECHNOLOGICAL RENEWAL

1. How much do you contribute to the commercialization of research results?

2. To what extent do you use portals to find IP information ?

3. Are you motivated by the compensations structure to contribute to R&D output?

B: APPROPRIATION OF TECHNOLOGICAL KNOWLEDGE

4. In the last five years, approximately a patent application was filed for approximately what percentage of your company's product and process innovations?

5. How many of your inventions over the last 5 year have led to patents now?

6. In the last five years, approximately what percentage of research results got published?

C: THE PROTECTION OF INTELLECTUAL PROPERTY

7. During the last five years, how effectively was the protection of the inventions you contributed to?

8. In the last five years, approximately for what percent of the cases was litigation prevented (e.g. by sending out a warning or by offering (cross) licenses)?

D: DISSEMINATION OF TECHNOLOGICAL KNOWLEDGE

9. How often do you look in patent databases to find information in patents belonging to competitors?

10. Are you actively involved in working on the patent portfolio?

E: QUESTIONS CONCEIRNING FINANCIAL APPRECIATION

11. How would you rate the economic value of patents in your portfolio?

12. How would rate the strategic value of patents in your portfolio?

F: LIABILITY

13. In the last five years, what is the percentage of infringement claims made on inventions?

14. In the last five years, what the percentage of inventions are put to use?

G: THE USE OF PATENTS FOR PERFORMANCE INDICATION

15. When searching for a partner, is the identification of options and data retrieval done based on patent information?

16. When different options are assessed, is the patent portfolio the decisive factor in choosing a partnership?

H: STATEMENTS CONCERNING PATENT PORTFOLIO'S

20. How would you rate the power of individual patent claims?

21. To what extent are your patents in your technology portfolio unique, independent, and have less knowledge spillover ?

22. Patents citations used in your portfolio belong to a wide range of technological field

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