CHALMERS

A study of patent portfolio benchmark methodologies

An analysis of the situation in the telecom industry

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ABSTRACT

The telecom industry has seen a globalization of its business and the widespread use of communication services demand interoperability between suppliers, operators and manufacturers over nation and continent boundaries. The rise of telecom standards has enabled companies to jointly develop technology and set up networks for interoperability where several actors can contribute with technology. When technology standards emerge in the telecom industry more actors take part in the standardization process and the need for adequate patent portfolio benchmark increase. But, the existing benchmark studies show low consensus which creates uncertainties for how to interpret their results.

The thesis has the purpose of providing an understanding of how patent portfolio benchmark methodologies are constructed. This has been done by settting up a set of research questions that covers patent benchmark studies and their relation to patent portofolio management.

Existing literature describes technology intelligence factors and how to make patent portfolio management decisions based on these. The literature further describes that patent data can be used when trying to distinguish strong patent from patents with low strength. The area of patent value is described by looking into the different kinds of value adding activities where patents can be used.

The empirical data reveals that the studied patent portfolio benchmarks use different methodologies to determine the reletive strength of patent portfolios. The use of sample source and indicators has significant impact of the outcome of the benchmark as well as the degree of technology mapping. The detailed study of patent citation's relation to company internal assessed relevance of a patent portfolio shows that a portfolio with high assessed relevance also has got a higher average of citations.

By analyzing the charecteristics of the benchmark methodologies advantages and disadvantages has been discussed. Many of the identified disadvantages depend on how the sample of patents has been filtered. The variety of sources and filters available for selecting your patent sample in an benchmark let the analyst exclude patents that might be of low relevance for the technology field in focus.

The distribution of citations per patent in a portfolio shows that a citation analysis of a patent portfolio should be done with caution. The large amount of non cited patents even in a high relevance portfolio shows that a citation analysis only will identify a small fraction of potentially important patents in a portoflio.

None of the studied benchmarks capture the complete picture of the patent portfolio. The conclusion further highlights the importance of having awareness of each methodology's limitations when trying to construct a benchmark. By clearly defining the purpose of the analysis the patent portfolio manager will simplify the selection of the patent sample and make it easier to interpret results.

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1 INTRODUCTION

This section will give an introduction and background to the purpose of the thesis. The research questions of the thesis will be presented and discussed. Lastly, the delimitations of the thesis will be presented

Today's emerging telecom standards has changed the way global ICT is being developed. The more open and collaborative development has made the ownership of the developed technology widely spread among the contributing actors. As a result of this, the joint development of recent telecommunication standards such as GSM, UMTS and LTE has created an IPR-landscape that is intervened with patents belonging to manufacturers, operators and technology providers.

Today, several attempts to describe the relative strength of these actors' portfolios exist. But, neither of them has gained a strong position as the clear choice for determining patent portfolio strength. The main problem with analyzing the strength of a patent portfolio is the contextual nature of a patents value.

This report will try to look into the existing analytical frameworks that are used to analyze patent portfolio strength. The analysis of the frameworks will be connected to the special case of open standards in the telecom industry. In practice, this will be done through describing the characteristics as well as advantages and disadvantages of some of the existing benchmarking methodologies. Additionally, an analysis of a patent portfolio from Ericsson AB, a Swedish telecom company, will be analyzed. This analysis will map Ericsson's internal view of important patents to the results of using existing patent portfolio benchmark methodologies.

1.1 GLOSSARY

Cross-licensing – When two actors contractually grant rights to each other's IPRs. (Wikipedia, 2012)

ETSI – European Telecommunications Standards Institute, a non-profit and independent standardization organization. (About ETSI, 2012)

GSM – Global System for Mobile Communication, standard set by ETSI to describe the second generation of digital cellular networks (Wikipedia, 2007)

LTE – Long Term Evolution is the global standard for the fourth generation of mobile networks (4G) (3GPP, 2012)

Patent Portfolio - a collection of related patents, held under common control. (Parchomovsky, 2005)

3G – 3rd Generation mobile telecommunications, a generation of mobile telecommunication standards that complies with the International Mobile Telecommunications-2000 specifications. (UMTS World, 2003)

3GPP – Third Generation Partnership Project, a collaboration between telecommunication associations also called organizational partners. 3GPP has the main function of developing telecom standards related to GSM, 3G and LTE. (3GPP, 2012)

1.2 BACKGROUND

Many industries, such as the telecom industry, has been undergoing a paradigm shift in how to develop their products and more importantly how they commercialize their new technologies. A shift towards open innovation, in contrast to closed innovation, has lead to new opportunities and new business models. Chesborough (2006) refers to this change as *"The new imperative for creating and profiting from technology".*

1.2.1 OPEN VS CLOSED INNOVATION

The closed innovation paradigm was characterized by internal research and development with the aim to produce products and sell them to the customers, see Figure 1. The internal focus was partly dependent on the university scientists' lack of interest for commercialization of research results. (Chesborough, 2006) This gave no choice for the industrial actors than to develop their technologies internally. The knowledge that was obtained from the internal development was only exploited through internal product development. The competitors, who took on the same development strategy, had to rely on their own internal development and there were very little spillover effects. (Chesborough, 2006)

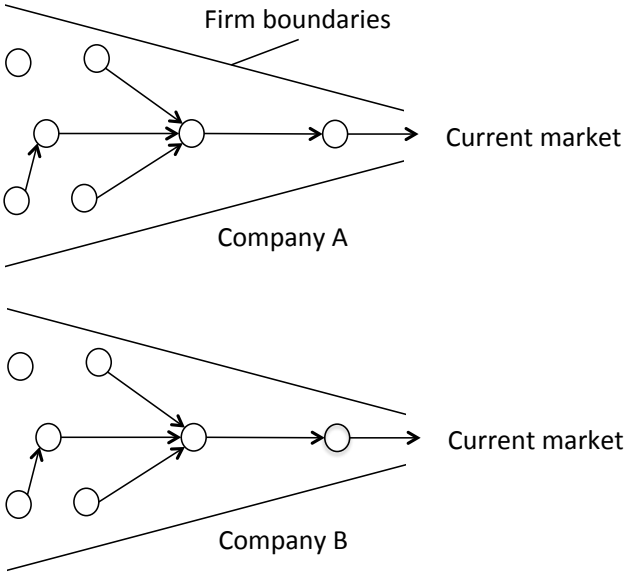

Figure 1 - Closed Innovation, source: (Chesborough, 2006)

The closed paradigm required that the company was able to save the developed knowledge in a bank until a business further downstream was ready and willing to use it. (Chesborough, 2006) However, several factors have made it difficult for companies to maintain a competitive advantage with the closed approach to innovation. The increased worker mobility, the easier access to venture capital, the shorter product life cycles and the external suppliers increased capability to deliver components with sufficient quality has eroded the

incentives for a closed approach and forced companies to change their innovation strategy. (Chesborough, 2006)

The closed innovation paradigm has in many industries been replaced by the open innovation paradigm. The open innovation paradigm is characterized by a different knowledge landscape compared to the closed innovation paradigm. (Chesborough, 2006) The knowledge is more widely distributed and companies will find valuable knowledge outside the boundaries of the firm, see Figure 2. (Chesborough, 2006)

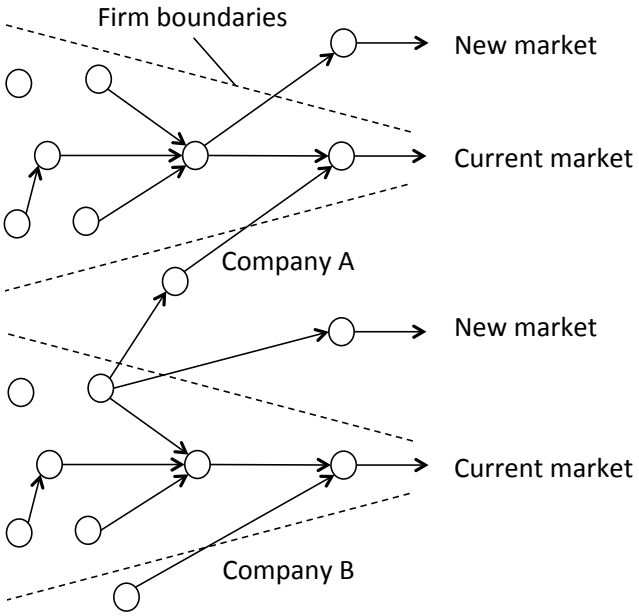

Figure 2 - Open Innovation, source: (Chesborough, 2006)

The open innovation paradigm requires a new logic of innovation. Companies must seek leverage of the distributed knowledge instead of ignoring it. The fact that the knowledge landscape has changed has lead to a set of new business models that helps companies to capture value in an open innovation environment. (Chesborough, 2006)

The open innovation paradigm has also changed the role of IPRs. Companies in the closed innovation used IPRs mainly to establish design freedom for the internal product development. The management of the IPRs was not seen as critical for the business strategy. The role of IPRs have become much more important in the open innovation paradigm. The IPRs are used much more actively to create business opportunities and to find markets for the developed technology, e.g. through licensing. (Chesborough, 2006)

1.2.1.1 Standardization and markets for technologies

Alongside with the emergence of the open innovation paradigm, markets for technologies have been established. (Pénin, Hussler, & Burger-Helmchen, 2011) The diffusion of knowledge has made it possible for companies to trade knowledge and technologies between each other. The changed role of IPRs is very evident in these new markets where IPRs is not only a legal instrument to claim ownership but also an instrument to trade and build technical platforms in a collaborative setting (Petrusson, Rosén, & Thornblad, 2010).

IPRs, that before were used mostly to exclude others, have become a tool to regulate technology markets and more and more companies see IPRs as revenue driver instead of a cost driver.

Industries such as the telecom industry are dependent on technology interoperability, which can be achieved through standardization (Simcoe, 2006). Technology standardization is harmonizing the technology market and enables more efficient markets (Petrusson, 2004). Standardization leads to a competitive arena within the market instead of competition for the market which will reduce the risk of consumer lock-in (Shapiro & Varian, 1999).

Technology standards can be more or less open, meaning that it is more or less available for the interested stakeholders to implement. The degree of standard openness can be regulated using IPR where IPR holders that participate in the standardization will get an advantage of including technology covered by their IPR in the standard. (Petrusson, Rosén, & Thornblad, 2010)

1.2.2 THE COMPETITIVE ENVIRONMENT OF THE TELECOM INDUSTRY

As mentioned, standardized technology play an important role in the telecommunication industry and the actors in the industry are fighting to include their technical solutions in the standard. A company that proposes a solution to the standard is very likely to have a patent application claiming that technical solution. This means that an actor partaking in the standardization work is proposing a technical solution to the standard simultaneously as they are filing for patents claiming that technical solution. [1]

One reason behind the importance of having patents claiming technical solutions included in the standard is the cross-licensing of standard essential patents. A patent is essential if it is impossible to comply with the standard without infringing the scope of the patent. An actor with a large share of essential patents will generate net income from the cross-licensing agreements with actors that are holding smaller shares of the essential patents. This way, a portfolio of many standard essential patents has become an important competitive advantage in the industry. (Bekkers, Bougard, & Nuvolari, 2009)

A standard is often built up on technology protected by IPRs belonging to a wide range of companies and intervened together. If one actor refuses to give or put unreasonable terms on his license he can prevent the standard from being adopted, patent hold-up. Since the idea of a standard is to allow interoperability between different manufacturers and users the importance to avoid patent hold up is very crucial for the success of the standard. (Shapiro, 2001)

To avoid patent hold-up the contributing actors need to be coordinated to allow accessibility on reasonable terms. However, in order for this to work it has to comply with antitrust laws, which prevent companies to set fixed royalties or in any kind limit the competition on the market. One way to solve this is to create a standard setting organization which make sure that all contributing parties agrees to offer their contributed technology under certain terms that will allow everyone to gain access to the standard. (Shapiro, 2001)

[1] Interview with Monica Magnusson February 3, 2012

1.2.2.1 The standardization procedure

The technology standardization in the telecom industry is, for the case of GSM, 3G and now LTE, done in a consensus style within the forum of the formal standardization organization, Third Generation Partnership Project, 3GPP(3GPP, 2012). 3GPP is a result of the European Standards Institute's recognition that third generation wireless communication was no longer solely a European project. In order to build a global standard the participation of actors world wide was necessary and 3GPP was constructed. (Hillebrand, 2001)

3GPP develops technical specifications that are to be adapted by regional standard organizations. The actors within the telecom industry must then adapt their technologies so that they are compliant with the set standard. (About ETSI, 2012) The development of technical specifications is driven by the members of 3GPP, see figure 3. To be allowed to make contributions to the standard you need to be a member of any of the regional Organizational Partners (OP) that co-operate with 3GPP. These OP:s are standardization bodies from Asia, Europe and North America, where Europe's OP is called ETSI. To become a member ETSI, you basically only need to pay the membership fee. This means that any organization willing to participate in the standardization procedure is allowed to do so. However, the size of your company affects your membership fee as well as your contribution level. (ETSI Directives, 2012)

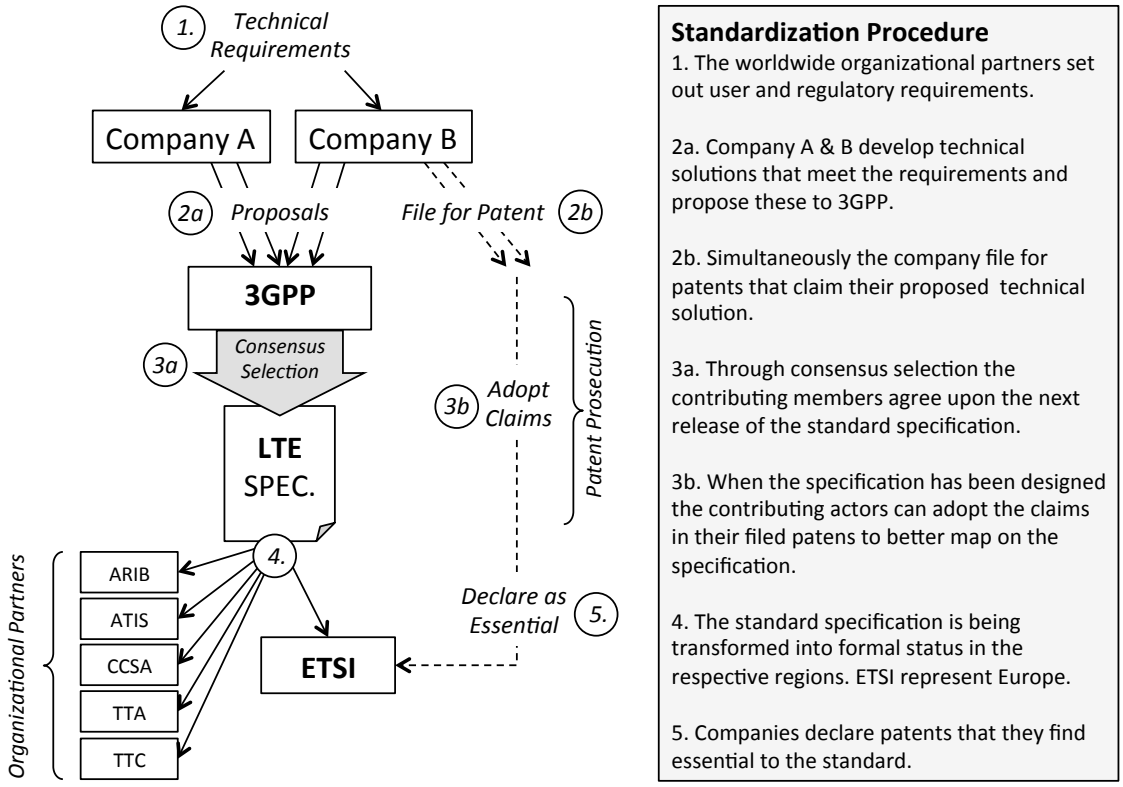

Figure 3 - Standardization procedure within 3GPP, source: ETSI directives, 3GPP about & interview with Monica Magnusson February 3, 2012

3GPP is fed with both user and regulatory requirements worldwide by the OPs. The individual members in certain working groups then develop the technology, which later

becomes part of the specification through consensus among the 3GPP members. (3GPP, 2012)

As an Organizational Partner you are obliged to apply appropriate procedures to make the standard into a formal status in your respective region. In the case of ETSI this is done automatically since ETSI has chosen to automatically recognize the output from 3GPP as an ETSI technical specification. This has significantly shortened the time between the 3GPP publication and the transposing into formal status in the region. (Hillebrand, 2001)

The members of ETSI are obliged to disclose any IPR they possess that might be essential to the standard. An IPR is essential to the standard if it would be impossible not to infringe that IPR for an actor who is producing, selling or otherwise commercializing equipment or methods that comply with the standard. This disclosure, commonly called declaration, should be done in "a timely fashion However, the declaration of essential patents does not include any sanity check whether the patent is truly essential or not (Mallinson, 2011). Some argue that the ETSI database of declared essential patents suffers from "over-declaration" in the sense that some companies declare patents that are not essential for the standard. This means that the use of the ETSI database as a source for essential patents is not fully reliable since it may include patents that are not essential. [2]

1.2.2.2 FRAND

The market for standardized technology is enabled by the use of IPRs and primarily patents. All actors that participate in the standardization process of 3GPP have to declare patents that possibly are essential to the standard to ETSI. The declaration of the standard essential patents gives the actor the right to claim that the patent is standard essential but it also implies that the actor has to license the patents under the FRAND commitment. (Ramírez-Mireles, 2010)

By declaring an IPR as essential the actor agrees to grant licenses to this IPR on fair, reasonable and non-discriminatory terms, (FRAND). The license should allow a licensee to manufacture, sell, repair or use equipment or methods that would otherwise infringe the IPR. The terms of the license should be as the name suggest, fair, reasonable and non discriminatory. (ETSI Directives, 2012) However, the definition of such term is not explicitly stated in any ETSI document.

As a standard grow and gain recognition as the global communication infrastructure the importance of avoiding patent hold-ups increases. If an actor wouldn't declare his patents and refuse to license his IPR under FRAND-terms there might be a situation where this actor can jeopardize the success of the standard by abusing its control position and charge unreasonable royalty rates and thereby impeding the growth of the standard. By having all contributing members agreeing to FRAND-terms you can avoid these situations and make sure that the standard is available on "fair and reasonable" terms. (Shapiro, 2001)

[2] Interview with Monica Magnusson February 3, 2012

1.2.2.3 Principle of proportionality

The principle of proportionality avoids royalty levels above technological value and makes sure that manufacturers can afford to bring a product containing the technology standard to the market. This royalty model is based on that it is possible to determine the relative strength of patent portfolios belonging to different companies, see Figure 4. (Hytönen, Jarimo, Salo, & Yli-Juuti, 2011)

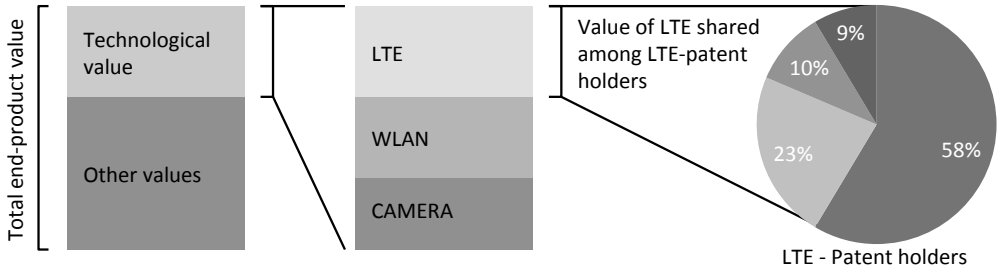

Figure 4 - Principle of Proportion, adopted illustration from (Hytönen, Jarimo, Salo, & Yli-Juuti, 2011)

Royalty payments determined according to the principle of proportionality means that the technological value is determined as a share of the total end-product value. Technological value can then be divided into different kinds of technology. When the technological value is shared among the technology providers it should be calculated on the basis of the respective strength of each contributing patent portfolio.

In the case of LTE this means that relative strength of 50 companies needs to be determined. Since this would imply significant amount of time and effort from any company and analyst companies, one must find other ways to determine the relative strength. As a result of this many of the recently published reports has attracted a lot of publicity even though they seem to differ in result significantly. (Mallinson, 2011)

1.2.2.4 Importance of perceived patent portfolio strength

The vast amount of patents and the increasing number of actors that compete in the telecom industry has made the relative strength of an actor's patent portfolio an important factor when comparing companies against each other. The perceived strength of a company's patent portfolio has significant impact on several levels.

Since IPR licensing has become a more important revenue driver for telecom companies the perceived patent portfolio strength influence investors and their expected return on investment. On another level, because of the complexity of determining the patent portfolio strength, competitors are influenced by the perceived patent portfolio strength of another company. This perceived strength affects the starting point before a negotiation of licensing terms.[3]

The recent benchmarking reports show little consensus when comparing their results, this has been noted in a report from Keith Mallinsson. His report shows the low correlation between recently published reports, which claim to measure the same thing, the amount of standard essential patents by company. (Mallinson, 2011) The charts in Figure 5 show the

[3] Interview with Björn Gudmundson, February 3, 2012

results from three different industry reports that have analyzed how many patents each actors holds that are assessed to be essential for the LTE standard. The charts highlight the lack of consensus that previously has been discussed by Keith Mallinson. Note that the studies have been conducted at different points in time, which partly may explain the discrepancy in the result. [4]

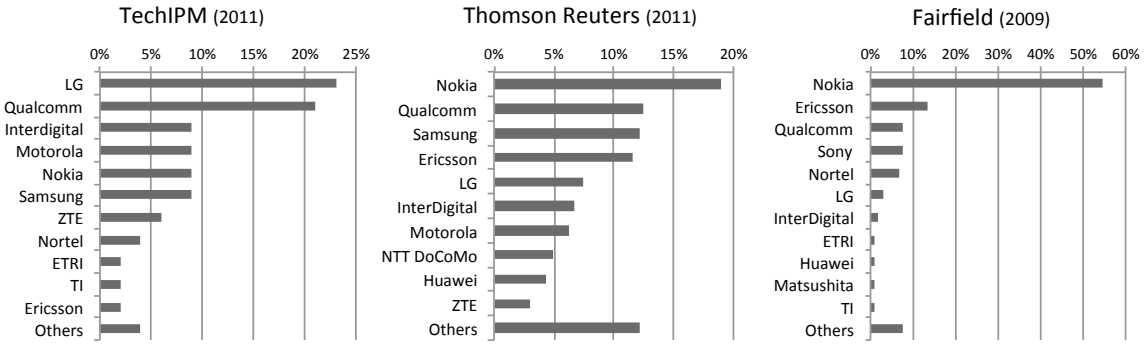

Figure 5 - Sample of results presented in industry reports

1.3 PURPOSE OF THE STUDY

Since there seem to be a lack of consensus regarding which aspect to consider when evaluating the patent portfolio strength, the purpose of this study is to:

Provide an understanding of how patent portfolio benchmark methodologies are constructed.

The thesis intends to discuss different patent portfolio benchmark methodologies from a patent portfolio management perspective.

1.4 RESEARCH QUESTIONS

The main research question for this study is:

Looking at the telecom industry, how can patent portfolio benchmark be used in patent portfolio management?

In order to answer the main question, three sub questions have been developed to target different areas that are important to the field of the study. The sub questions will also be of help to limit the scope of the study. The three sub questions are as follows:

1. *What are the characteristics of existing benchmark methodologies?*

With industry reports circulating on the market it is important to understand what these reports are measuring and how the methodologies of the reports are constructed. From a management perspective, it is important to understand the possibilities to use patent portfolio benchmark. An understanding of the characteristics of the benchmark methodologies will help the manager to decide what to measure and how to construct the benchmark study.

[4] Displayed results are from three of the industry reports that are used as empirical data in this thesis. The purpose with figure is to give the reader a better understanding of the context and phenomena that the thesis aims to address.

2. *What are the advantages and disadvantages with the existing methodologies?*

Benchmark methodologies have different approaches and use a variety of assessment criterions. In order to interpret these results you need to provide a good understanding of what they try to measure and how the results can be used. The discussion will take a starting point in the differentiating elements that have been identified in the studied methodologies.

3. *How can companies use patent data to support the internal evaluation of their patent portfolio?*

With some of the benchmark studies that have been identified being based on an analysis of patent data it is of interest to see if there is a relation between said data and a subjective assessment of the patent's relevance for the company. This question will help to understand if benchmark studies that are based on analysis of patent data can support the internal management of the patent portfolio.

1.5 DELIMITATIONS

Considering the scope and purpose of the thesis, the following delimitations of the thesis should be highlighted.

- Other industries than the telecom industry will not be considered
- The empirical data will only focus on methodologies that determines patent portfolio strength
- The results of patent portfolio benchmarks that have been presented in different industry reports will not be discussed

The choice of concentrating the study on the telecom industry is a consequence of the fact that the thesis is developed in collaboration with Ericsson AB. The phenomena of measuring patent portfolio strength have implications for the companies in the telecom industry that might not appear in other industries. Hence, by only focusing on patent strength in the telecom industry it will be possible to have a more focused discussion and a better definition of the problem.

The focus of the thesis is to discuss different approaches to measure patent portfolio strength. Much of the data that have been used for this thesis comes from various industry reports that have compared the patent portfolios of the different actors in the industry. There are several published industry reports that look at the telecom industry from other perspectives than patent portfolio strength. Such reports have not been included in the empirical data since this thesis does not aim to discuss the telecom industry as a whole but rather focusing on the phenomena of patent portfolio strength.

Lastly, the studied industry reports often presents ranking lists of the actors with the highest level of patent portfolio strength. These rankings will not be further analyzed in the thesis since the thesis is aimed at understanding the methodologies behind the ranking lists. The thesis does not aim to decide which actor in the industry that holds the strongest patent portfolio and neither will the credibility of the ranking lists be discussed.

2 METHODOLOGY

This section will describe how the thesis has been conducted and discuss the choices of methodology that has been made in the study. The chapter starts of by describing the research procedure and then discusses how data were gathered and analyzed. Lastly, the chosen research methodology will be critically discussed.

The used research procedure has enabled a structured approach to fulfill the purpose of the thesis. By developing three sub-questions that all contribute to the main research question the project could focus on solving smaller issues within the research area. The research procedure has allowed an iterative process where additional data and literature has been studied in order to provide an adequate analysis even if the stage of literature study already had passed. The research procedure is illustrated in Figure 6.

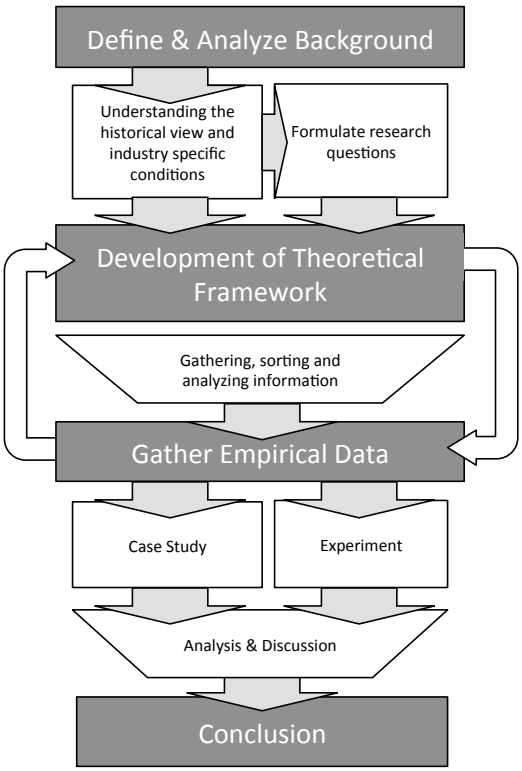

Figure 6 - Graphical illustration of research procedure

2.1 DEFINE PROBLEM AND ANALYZE BACKGROUND

In order to gain understanding of the usage of patent portfolio strength benchmarks and their underlying problems unstructured interviews with employees at Ericsson's patent strategy and portfolio management department has been conducted. These persons have a key role in Ericsson's licensing decisions and helped us understand the underlying problem of patent portfolio benchmarks. Thanks to the cross-functionality of Ericsson's licensing team a wide range of experiences and opinions have contributed to the overall understanding of patent portfolio benchmark indicators.

The combination of industry insight and literature creates an objective description of the complex background where the contextual definitions need to be considered. The

background creates the reference framework for the further analysis and has made sure that the research remains within its scope.

2.2 DEVELOP THEORETICAL FRAMEWORK

One of the cornerstones in research methodology is the literature review. By reviewing the literature on the relevant subjects for the study we have been able to learn from others' findings as well as avoiding reinventing the wheel. The literature review has also provided us with arguments that have been used to discuss the findings of our study. A literature review can be done with either a systematic or narrative approach (Bryman & Bell, 2011)

The systematic review is suitable when the researcher seeks for supporting arguments for their evidence-based conclusions. This is often the case in research regarding medicine. The systematic approach follows a structure where the researcher starts by specifying questions to which the researcher aims at finding questions in the reviewed literature. (Bryman & Bell, 2011)

The narrative approach to literature review is more often used in science about management since there is less consensus on which the key research questions are and how to answer them. The aim with a literature study using the narrative approach is to generate an understanding of the field rather than gathering the accumulated knowledge. (Bryman & Bell, 2011)

In this study we have used a narrative approach since the area of patent portfolio strength is used in many different ways with several contextual definitions to the term. The literature review for this study is therefore aimed at understanding different indicators of patent portfolio strength indicators, their use in patent benchmarking and portfolio management.

Databases and online search engines, such as Google scholar, has been used to identify literature relevant for this study. We have also used the reference lists in the articles to identify additional literature that is of interest. This has given us a snowball effect and also enabled us to find areas of interest that was not part of the initial plan.

2.3 COLLECTION OF EMPIRICAL DATA

In order to be able to answer the research questions, data has to be collected. For this study, three sources of data have been used; Industry reports, interviews as well as a data from an experiment. The industry reports and the interviews form a case study that describes how patent portfolio benchmarks are designed in the telecom industry. These two sources will complement each other in the way that the industry reports will create the starting point for further investigation while the interview study will give us more detailed input for the particular case of patent portfolio strength in the telecom industry. The data from the experiment will let us test if there exist a relationship between internal assessed relevance and patent data.

2.3.1 CASE STUDY

A case study has been conducted in order to complement the literature review and to gather data on the specific case of standardized technology within the telecom industry. The Case study design is widely used in business research according to Bryman and Bell (2011).

The authors further state that the case study often is used when the researchers want to distinguish unique features of the case. The data for the case study has been gathered through industry reports and qualitative interviews since it gives us enough flexibility to cover different aspects the investigated methodologies. (Bryman & Bell, 2011)

2.3.1.1 Data collection from industry reports

As a primary source of information the data provided through the benchmarking report and disclosures about the methodology on their website has been used. The industry reports formed the basis for the case study by describing how patent portfolio benchmarks are designed in the telecom industry.

For a complete list of investigated benchmark studies, see Appendix I – Patent Portfolio Benchmark Studies.

2.3.1.2 Interviews

The study of industry reports has been complemented with interviews. These interviews have been conducted with a representative from the company producing the ranking and has filled in the information gaps as well as given the research team more insight of the underlying assumption when an indicator is used.

Semi-structured interviews were used to gather different stakeholders opinions about the specific subject. The semi-structured approach gave us the flexibility to ask unplanned follow up questions when needed but still enabled us to maintain an overall structure of the interviews. An interview guide was developed to support the structure of the interviews. (Bryman & Bell, 2011) During the interviews, the focus was to ask open questions with more specific questions to follow up and ensure that we have understood the interviewee correctly.

For a list of interview objects, see Appendix II - Interviews

2.3.2 PATENT-DATA EXPERIMENT

In order to further support our case study we have chosen to look more closely into some indicators and tried to apply and evaluate these on the case of patent related to a telecom standard. This has been done by selecting a set of patents held by Ericsson AB, a Swedish telecom actor. The examined patents are highly related to the same telecom technology standard and have been internally ranked through a relevance classification system. By analyzing these patents and comparing their patent data with the internal relevance classification we created a data set for investigating how patent data indicators relate to other more qualitative indicators.

The research team has chosen to look closer into citations as the patent data based indicator. This decision was based on three facts.

First, literature frequently mentions citation analysis as a way to assess a patent's importance. This in combination with the use of citations in some of the studied methodologies gives us a validation that the indicator is considered to reflect some important aspect of the patent.

Second, citations are a measure that easily can be extracted from a patent mining software and let us extract the desired data from a large sample. For this study we used Thomson Innovation as the source for citation data.

Finally the investigation about citations' relation to internally assessed relevance will contribute to existing literature the most since we have been able to use internal information about a patent portfolio that otherwise wouldn't have been available.

The extraction of publically available patent data was done with the help from Thomson Innovation, a patent analysis software. The software enabled extraction of citations between patents and patent families.

2.4 DATA ANALYSIS

The data has been analyzed using a combination of qualitative and quantitative approach. The approach of analysis has been determined partly based on the characteristics of the data but also with the goal of the analysis in mind.

2.4.1 ANALYSIS OF CASE STUDY

The data that has been collected through the case study has been analyzed using a qualitative approach. The framework of grounded theory has been used to structure the analysis. Grounded theory is an iterative framework that aims to develop theory based on the collected data. (Bryman & Bell, 2011) This thesis have no intention to develop a new theory in the subject but the process of grounded theory suits the purpose of the research. The framework has let us structure the analysis by using the tool of coding to create categories that has enabled us to describe the characteristics of the data.

Coding is often described as the key process in grounded theory. It is a process where the data is broken down into its components. The coding yields indicators that can be used to create concepts and later categories (Bryman & Bell, 2011) The Generation of concepts and categories has been done in parallel with the coding of the data. The parallel approach has forced us to iterate the coding and creation of categories as more data has been collected. This approach has allowed the analysis to capture the complexity of the phenomena of patent benchmarking.

2.4.2 ANALYSIS OF EXPERIMENT

A quantitative approach has been used to analyze the relationship between patent data and Ericsson's relevance rating. Unvariate analysis has been used to study the data and the relation between the relevance rating and the patent data. By using a combination of studying central tendencies as well as the variation in the dataset it has been possible to capture different aspects of the data. (Bryman & Bell, 2011)

2.5 METHODOLOGY CRITICISM

The construction of a research methodology may suffer from some flaws in relation to the research purpose. The constructed methodology has through the process of this project been carefully analyzed in every step. A few critical steps have been identified and the following section will discuss the impact of these steps.

The selection of studied benchmark reports make up one of the most critical aspects of the methodology. This step was created with the help of Ericsson employees in order to determine the most relevant studies. This made the selection process not completely objective but has still been assessed as creating a good outcome in terms of a study of benchmarks relevant for a telecom actor. However, a more objective approach could have resulted in identification of more and yet not discovered patent benchmark methodologies.

Another aspect of the limitation when studying benchmark methodologies is the access to information. Due to the benchmarking producing companies' business models the sharing of information about their methodologies is highly restricted. If the access to information would have been more open, the project could have analyzed more methodologies. However, the studied methodologies have still provided the project with enough empirical data to answer the research questions and draw the necessary conclusions.

In the patent-data experiment a set of Ericsson patents were analyzed. These patents were selected trough their relation to a certain telecom technology. The selection of this technology were done on the basis of were we could find a satisfactory data set with the information required to conduct the analysis. Since the availability of such a dataset were highly dependent on the patent portfolios that could be found within Ericsson, the search for these portfolios did not become very exhaustive. However, by selecting patents that belong to Ericsson were able to extract data that wouldn't have been accessible otherwise.

Even though some critical steps exist the overall the research methodology has been carefully designed to stay objective and provide well-argued conclusions for the research questions.

3 THEORETICAL FRAMEWORK

The theoretical framework aims to describe concepts that are of relevance for the purpose of this thesis. Existing literature on the topic is presented that will be used to support the discussion of the empirical data. An introduction to the area of patent analysis will be given which will lead into a discussion on different indicators that are used to analyze patents and patent portfolios.

3.1 INTRODUCTION TO PATENT ANALYSIS

The intellectualization of the economy requires companies to become better at managing their intangible assets, such as Intellectual Property. The ability to convert intellectual assets, including IP, to value is important for companies and Intellectual Property management has been developed as a system of processes that support this conversion (Davis & Harisson, 2001).

Analyzing patents can give the company information both about internal conditions and external factors that may influence the company's strategic decisions. (Ernst, 2003) The analysis of patents can be used to support different strategic decisions both internally and externally. Intellectual Property (IP) management may be an obvious area but also other functions, such as competitive and technology intelligence can benefit from analyzing patents and patent information. (Breitzman & Mogee, 2001)

Patent analysis can support IP management in various ways. It can be a tool for organizing the company's patent portfolio but patent analysis can also be used to look outside the company and support decisions on technology transfer and cross-licensing. (Breitzman & Mogee, 2001)

Organizing the patent portfolio is an important step for a company that wants to manage their patent portfolio. The first step is to know what patents the company possesses. Second, the company must understand the strength and weaknesses of their patent portfolio. A good way to do this is to organize the patent portfolio by technology, product or business unit. (Breitzman & Mogee, 2001)

Companies that want to become better at managing IP first need to identify what they have in their portfolio. Portfolio mining is a tool that can be used to do this analysis and to categorize the content in the portfolio. The aim is to better understand the portfolio content and to develop strategies on how to improve the portfolio. Three different approaches to patent mining, see Table 1, can be used and which to choose depends once again on the purpose with the analysis but also on the resources allocated. (Davis & Harisson, 2001)

Approach	Description
Mine every piece of dirt	Examine all patents in the portfolio to find valuable patents
Shoot for low hanging fruit	Does not examine every patent, but uses computers and subjective judgment to find the first items that should be commercialized.
Statistical sampling method	Extrapolate values for the entire portfolio based on examination of a sample of the portfolio

Table 1 - Approaches to portfolio mining. Source: (Davis & Harisson, 2001)

Analyzing patents can also be used to monitor competitors and to perform technology assessments. By using different indicators the company can use patents and patent information to obtain knowledge about the competitors patenting strategies. (Ernst, 2003) By analyzing the competitors' patents it is possible to gain understanding of what the competitors are doing in the technology field and if there are any new competitors that need to be further analyzed. (Breitzman & Mogee, 2001)

3.1.1 INTELLECTUAL PROPERTY MANAGEMENT

Companies can derive value from their ideas and inventions through Intellectual Property (IP) Management. The value from IP can be derived in different ways depending on the firm's capabilities and the environment that the company acts within. The higher expectations a company has on the IP function, the more processes will be required in the Intellectual Property Management. (Davis & Harisson, 2001)

The different levels of expectations can be identified by using the Value Hierarchy framework, see Figure 7. This framework shows that a company that desires to reach a higher level in the hierarchy first needs to master the lower levels of the pyramid. (Davis & Harisson, 2001)

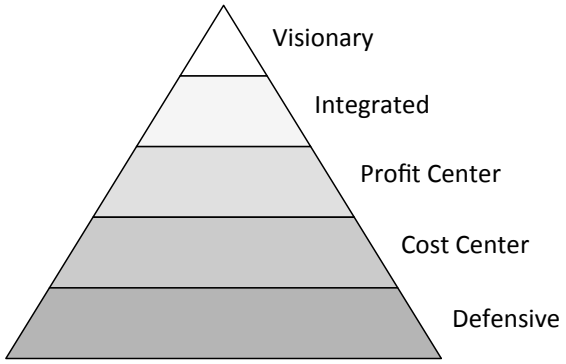

Figure 7 - The value hierarchy. Source: (Davis & Harisson, 2001)

The expectations of each level of the hierarchy are described in Table 2. In short, the first two levels, defensive and cost control, has an internal focus while the three higher levels also puts emphasis on the firm's environment and competitors. (Davis & Harisson, 2001) Companies on the three higher levels often seek to leverage their portfolio (Harrison & Sullivan, 2006)

Level	Expectations
Defensive	• Generate a significant number of patents for their IP portfolio • Ensure that their core business is adequately protected • Initiate basic processes to facilitate patent generation and maintenance • Initiate basic processes for enforcing patents • Ensure that their technical people have freedom to innovate
Cost control	• Reduce costs associated with their IP portfolios • Refine and focus the IP that is allowed into their portfolios
Profit center	• Extract value directly from their IP as quickly and inexpensive as possible • Focus on noncore, nonstrategic IP that has tactical (as opposed to strategic) value
Integrated	• Extracting strategic value from their IP • Integrating IP awareness and operations throughout all functions of the company • Becoming more sophisticated and innovate in managing and extracting value from the firm's IP
Visionary	• Staking a claim on the future • Encouraging disruptive technologies • Embedding intellectual assets and IA management into the company culture

Table 2 - Value hierarchy expectations. Source: (Davis & Harisson, 2001)

The internal focus of the two lower levels, defensive and cost center, requires companies at these levels two have suitable processes in place. These processes should be able to generate patents that will increase the protection of the company and to be able to defend themselves against potential infringers. The difference between Defensive and Cost center is that companies on the second level also need to look into how they can obtain the necessary protection in the most cost efficient manner. (Davis & Harisson, 2001)

Companies that have reached the third level, Profit center, and above in the value hierarchy use patents not only to protect the business of the company. They also see IP as a potential source of income, e.g. through licensing. Business opportunities have to be identified by looking outside the company's own organization and they will need to build capabilities that will allow them to analyze competitors and the environment. (Davis & Harisson, 2001)

3.2 Analyzing competitors

The intellectualized economy has driven a development where it has become interesting to evaluate and compare patent portfolios of one company with the portfolio of another company (Petrusson, 2004). Understanding your competitors can be an important factor when developing the strategy for extracting value from the company's patents. A tool that can be used to understand the competitors is a competitive assessment. (Davis & Harisson, 2001)

Harrison states that doing an assessment of the competitors can be an important part of intellectual property management. Information from such an analysis can be used to evaluate opportunities to extract value from the patent portfolio by answering questions illustrated in Figure 8.

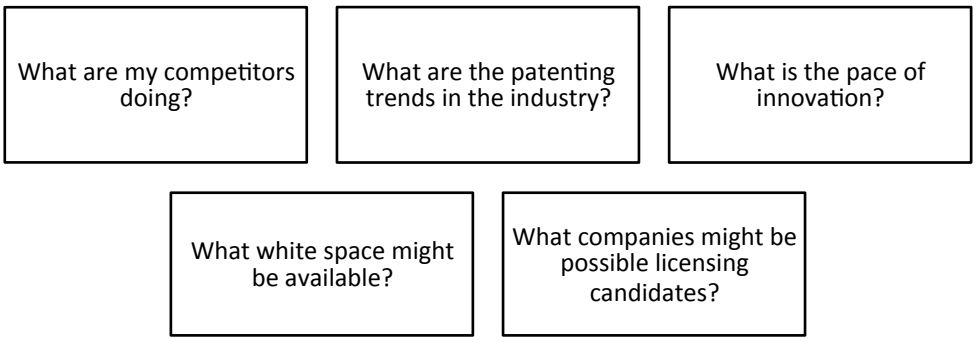

Figure 8 - Questions that can be answered by using competitor analysis. Source: (Davis & Harisson, 2001)

As mentioned, patent analysis can be used for technology intelligence. (Breitzman & Mogee, 2001) Lichtenhaler (2005) states that the choice of intelligence method is influenced by several different factors. First and foremost, the purpose with the analysis has to be considered. In general, the purpose can either be to generate information or to learn. When technology intelligence is used for learning, the goal is to internalize information to increase the number of possible actions. The learning can be either organizational learning or individual learning. Technology intelligence can be used to generate knowledge about the future, in order to identify potential threats and opportunities. Technology intelligence to generate information can be extrapolative, where past and current developments are translated into the future to develop the most probable picture. It can also be explorative, where the purpose is to identify possible future developments but not to identify the most probable future development. Lastly, information gathering can be normative. Here the starting point is an intended picture of the future and the aim is to identify possible ways that lead to that picture. (Lichtenhaler, 2005)

A tool that can be used to analyze a company's industry position is benchmarking. The idea behind benchmarking is to compare different factors that influence the performance to identify best practices that can be used to improve the company's performance. (Coers, Gardner, Higgins, & Raybourn, 2011) Benchmarking can be used in patent portfolio management to compare the efficiency of the patent organization with other companies'. By studying other patent organizations or patents from other companies, best practices and gaps can be identified. (O'Connel, 2008)

The focus of the competitive assessment can be either offensive or defensive. The offensive focus relates to scenarios where the company whishes to add new assets to the organization while a defensive focus relates to protection of the existing portfolio (Davis & Harisson, 2001). An underlying problem with these benchmarking efforts is that it is hard to separate the contextual purpose and the evaluation model. The evaluation models that exist look at IP as objects that exist and are possible to describe and analyze. (Petrusson, 2004)

3.2.1 INDICATORS FOR ANALYSING PATENTS

Many authors try to propose different indicators that intend to measure the strength or importance of a patent. (Wang, Garcia, Guijarro, & Moya, 2011) There exist several sources of data from where you can extract patent information. Today we have a wide range of regional (EPO, USPTO) and international (WIPO, INPADOC) patent authorities or organizations storing patent data. On top of these databases there are also organizations building databases collecting additional patent data to create statistical tools. (Kurtössy, 2004). The available data can be used in order to create proxies for patent portfolio strength. The following section intends to describe these indicators and how they have been used in literature.

3.2.1.1 Number of patents

To simply count the number of patents has long been considered not to be enough when trying to measure the value of a patent portfolio. However, the use of issued or applied patents for a given period of time indicates the pace at which companies files for new patents. It is not until you combine this measure with quality indicators you can produce a portfolio strength analysis. (Wang, Garcia, Guijarro, & Moya, 2011)

Counting patents or patent application may not give information on the efficiency and quality of the patent organization. It does however give a first indication of potential licensing opportunities and threats. Using this indicator can be a good first step to analyze the competitive environment but a deeper analysis on patent quality will be required if more granular information is desired. (Ernst, 2003)

3.2.1.2 Citations

Research has shown that citation data gives you an indication on a patent's technological importance. Citations can be divided into forward citation and backward, see Figure 9 (Xiao-Ping, Zheng, Gui, & Xiong, 2010)

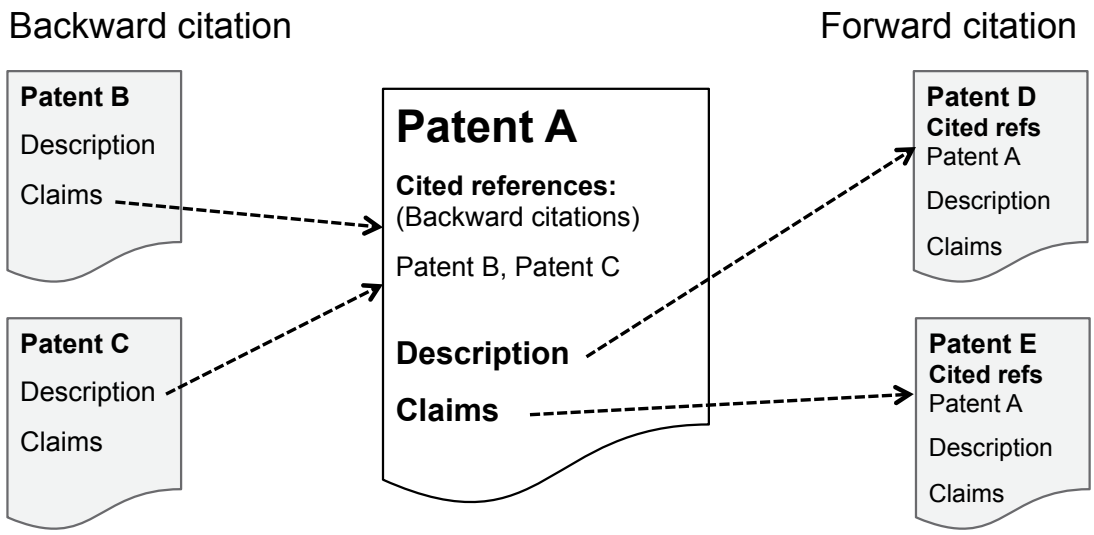

Figure 9 - Illustration of different kinds of citations, adopted from (Xiao-Ping, Zheng, Gui, & Xiong, 2010)

The references in a patent document can be seen as a flow of knowledge from one inventor to another and by that conclude that the cited patent had impact on the inventor of the new

technical solution. (Alcacer & Gittleman, 2006). In other words, the nature of a forward citation indicates that the patent paved the way for further technological innovation. The idea behind using citation instead of simple count of patents is that citations better illustrates the utilization of patented technology while patent count is a more a measure of how effective the input side of the innovation process is. (Trajtenberg M. , 1990) Continuing the argumentation, Trajtenberg states that using patent count assumes that all patents have the same value. However, the value of patents tends to be highly skewed with the majority of patents having a very low value. (Trajtenberg M. , 1990)

Trajtenberg claims that a way to solve the problems with using patent count as an indicator of value is to use citations as a value-index. More cited patents will be accounted a higher value and a weighted patent count is obtained. Time is an important factor to consider since older patents have had more opportunities to be cited but this can be adjusted by simply dividing the number of citations by the number of years that the patent has been available for citation. (Trajtenberg M. , 1990)

To only consider the number of citations in the USPTO has also been argued to be a too vague measure of patent value. Instead a citation analysis should be improved by considering the worldwide patent information which allows a better measure for how the patent builds upon other inventions worldwide and not only within its own jurisdiction. (Ernst & Omland, 2011). Ernst et al (2011) further argues that the technology field highly impacts the amount of citations received by a patent. Some technologies where the progress is incremental, inventions are intertwined or a high number of patents are applied for per year tend to also have a higher number of citations. Whereas in other fields where the progress is more discrete, improvement is more significant and a smaller number of patents are applied for tend to have a smaller number of citations. In a study made by Ernst et al (2010) they prove this statement by looking at citations rates of four different technology fields, see Figure 10.

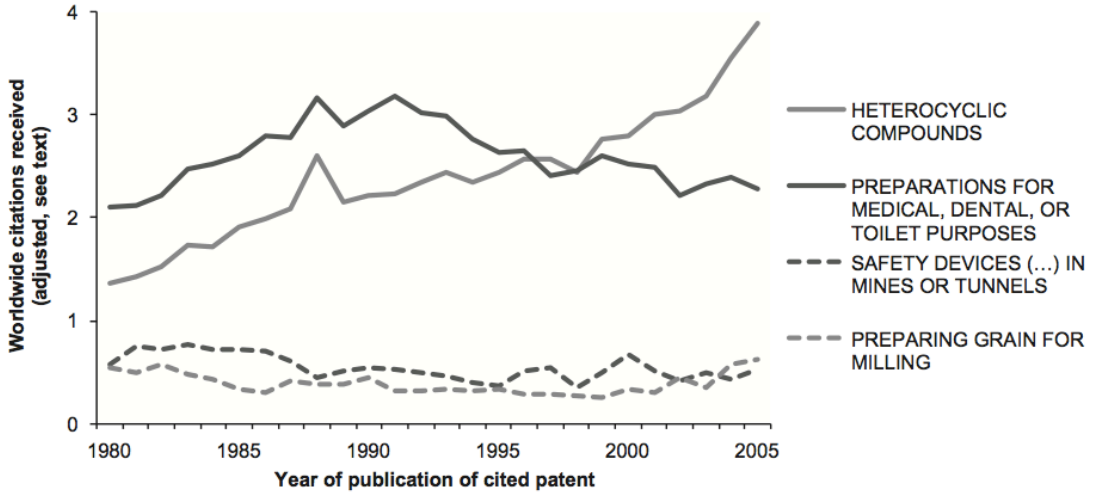

Figure 10 - Citation frequency in four different technology fields, source: (Ernst & Omland, 2011)

3.2.1.2.1 Patent Citations and technology standards

If we conclude that citations has a relation with patent value we might want to take this a step further and investigate if citations also show correlation with a group of patents declared essential to a standard compared to a group of none declared patents. Bekkers et al (2011) performed a study, which investigated the relation between patents declared essential to WCDMA and their forward citations.

The results showed that intrinsic technological value, the one indicated by forward citations, of a patent increase the probability that the patent is claimed to be essential. (Bekkers, Bongard, & Nuvolari, 2011) But it should be noted, as described in section 1.2.2.1, that the declaration of patents as essential to a standard includes no sanity check whether the patent is truly essential or not.

3.2.1.3 Claim characteristics

The actual scope of the patent is determined by the claims. But to qualitatively evaluate the claims in a portfolio of hundreds of patents takes significant amount of time and still needs to be contextualized in order to show relevant value. Barney (2006) has proposed a range of measures that can be used to create patent value analysis based on the characteristics of the patent claims. His approach has a starting point in the assumption that companies only continue to pay maintenance fees for valuable patents. Through looking at statistical data of a group of 100 000 patent issued until 1996 he show that different aspects of the claims can be related to the maintenance rate.

Figure 11 shows that maintenance rates show an increase with the number of independent claims. In the examined population 92.6% of the patents with more than 12 claims had an fourth year maintenance rate of 92.6% compared to 81.3% for patents having only one independent claim. This indicates what also can be seen as logical, that more claims give a broader scope and increase the chance of the patent remaining valid. Barney's study also shows that length of claims also correlates to the maintenance rate. Of the studied patents with less than 100 words per independent claims in average the fourth year maintenance rate was 85,9% compared with 79,9% for patent with word count of 500 or more. This indicates a small statistical proof of that having shorter claims is more valuable. (Barney, 2006)

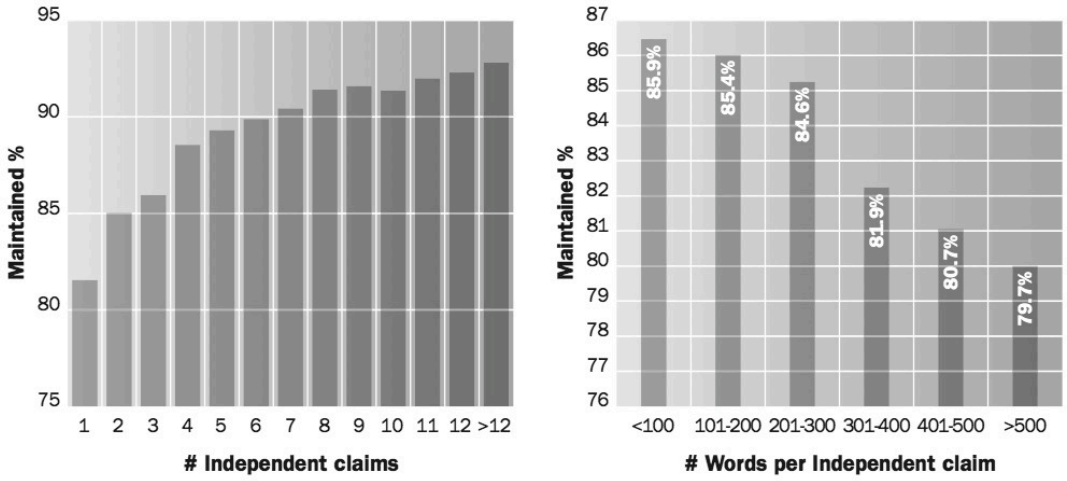

Figure 11 – Fourth year maintenance rate of different claim characteristics, (Barney, 2006)

3.2.1.4 Prosecution time

Barney (2006) further investigates other factors than claims that correlate to the likelihood of prolonging the patent for another four-year period. He argues that prosecution time serves as an indicator on patent value and that a longer prosecution time indicates that the scope of the patent has been better defined through a long discussion between examiner and applicant which mean that the scope is better defined and is more likely to hold in court (Barney, 2006).

3.2.1.5 Geographical Scope

Often, when determining the impact of a patent family's geographical scope only the main markets, such as United Stated, Europe and China are considered. A problem with this, addressed by Ernst et al (2011), is the fact that even though the patent family covers the main markets a patent's total market coverage is not considered. They propose a metric that considers the global market coverage based on covered GDP. By summarizing the total GDP covered by all members of a patent family you end up with a more accurate measure of market coverage. This can be further improved by using industry specific markets for each jurisdiction. (Ernst & Omland, 2011)

3.2.1.6 Summary of Patent Data Based Portfolio Indicators

The different indicators that have been discussed in the section above can be used standalone or in combination depending on the scope of the analysis. Table 3 provides a summary of the indicators.

Indicator	Description
Citations	Prior art references, backward and forward
Number of patents	Counting the number of patents in a portfolio
Claim characteristics	Claim length, use of limiting language
Prosecution time	Time between application and issue
Geographical scope	Family members in different jurisdictions

Table 3 - Summary of benchmark indicators

3.2.2 TECHNOLOGY MAPPING

A different approach to benchmark a patent portfolio is to map the patent against a specific technology. Such analysis can be done using claim-based valuation. The claim-based valuation method determines the value of the patent by identifying the impact of infringement. Since the scope of the patent is determined and limited by the claims. Thus should only the claims be considered when determining the patent value. (Eldering & Gisone, 2011)

The first step is to identify patents that can be interesting to analyze further. Patent mining based on three rating criteria: Claim breadth, Design-around and detectability can be used. Analyzing all patents in a portfolio can be time-consuming which is why patent mining is used to reduce the number of patents subject to analysis. (Eldering & Gisone, 2011)

3.3 DIFFERENT PERSPECTIVES OF PATENT VALUE

The evaluation of patent value is not a straightforward process. Gregory (2007), describes that patent value can be separated into economic value, public value and private value. Since this thesis aims at describing the role of patents benchmarks in relation to competitive assessments the focus of this section will be on a patent's private value, in other words, value captured by the patent holder. Gans & Stern (2003) discuss how patents can be used in different ways to create value and propose the following value adding activities where patents are used, see Figure 12.

Practise Value	License Value	Litigation Value	Defensive Value
•Producing and selling products •Exlude competitors	•Create licensing revenue •Value for others	•Patent suits •Settlements & damages	•Creates counter infringement claims •Increase negotiation position

Figure 12 - Different kinds of private patent value, source: (Gans & Stern, 2003)

Since all these activities show a different use of the patent as a company asset, the use of value indicators are expected to be different for each case. However, most of the indicators used today do not distinguish between the different kinds of value described above, something that has been pointed out by Gregory (2007). In his paper he identifies that many of the existing patent studies handle patent value in a generalized way and many case avoid discussing the differences between concepts such as patent strength, importance and quality.

Another view on patent value is the one provided by Pitkethly 2007. He describes the main difference between the measurement of a patent's value for the firm and the strength of a portfolio as that the basic measure of the valuation is to measure how much more return the patent can produce through any kind of exploitation in comparison to in absence of the patent. However, patent portfolio strength looks at the complete portfolio's strength in relation to a specific technology. (Pitkethly, 1997)

The main problem with determining patent value is that a direct measure of such value is almost impossible to achieve. This is in many cases a result of the limited access to such company specific information and the challenging task to tie economic numbers to specific patents. This is why the rise of indirect patent data based indicators has increased in use. (Gregory P, 2007)

Patent analysis methods have different purposes depending on how you conduct your analysis. A patent document, as well as a patent portfolio, has a wide range of data that can be extracted, sorted and analyzed. This patent-centric data can be compared with other data such as market and stock prize in order to create an analysis showing the relation between the patent and other patent external factors. By compiling a customized methodology using the desired metrics you create an analysis that measures a very specific aspect of a company's patent portfolio. The different applications can be divided into market based methods that becomes more of a patent valuation and technology evaluations that more measure the portfolio's strength in relation to a specific technology or field. (Breitzman & Mogee, 2001)

4 EMPIRICAL DATA

In this section, the empirical data will be presented. The empirical data has been gathered partly through a case study of patent benchmark reports from the telecom industry. The other part of the empirical data comes from an experiment where the relation between citations and internally assessed relevance has been analyzed.

4.1 CASE STUDY

This section will present the benchmark methodologies that have been identified during this study. The methodologies that are presented here are used by different analysts to analyze the patent portfolios of companies in the telecom industry using different indicators and with different purposes. There might of course be other analyst firms that use different methodologies than the ones presented but with insufficient transparency that made an analysis impossible. The methodologies that will be presented here are:

- Fairfield International resources
- Thomson Reuters
- Tech IPM
- Patent Pipeline Power
- IPQ Score

4.1.1 FAIRFIELD INTERNATIONAL RESOURCES

The company Fairfield Resources International (Fairfield) has constructed the probably most well-known patent portfolio benchmark methodology, illustrated in Figure 13. They have conducted patent portfolio benchmarks for both 3G and GSM rankings in the past and released a patent ranking for the LTE technology in January, 2010[5]. Responsible for the reports is Robert A. Myers together with David J. Goodman. They put together a team of 6 telecom experts with an average of 11.5 years of experience of engineering in telecom. The team members are experts in analysis and evaluation of mobile radio technology and equipment.

In earlier studies the team consisted of members with experience from the telecom standardization process but that team were too familiar with the standard specifications which lead to a situation where they were not able to assess if the patents were essential to the standards in the given time budget according to Robert A. Myers. Hence, the team members were replaced and the new team has limited experience from working with the standard specification. They were chosen on the basis of their technical knowledge and were given instructions on how to read and interpret the standard. [6]

[5] Review of patents declared as essential to LTE and SAE (4G Wireless standards) through June 30, 2009
[6] Interview with Robert A. Myers on February 9, 2012

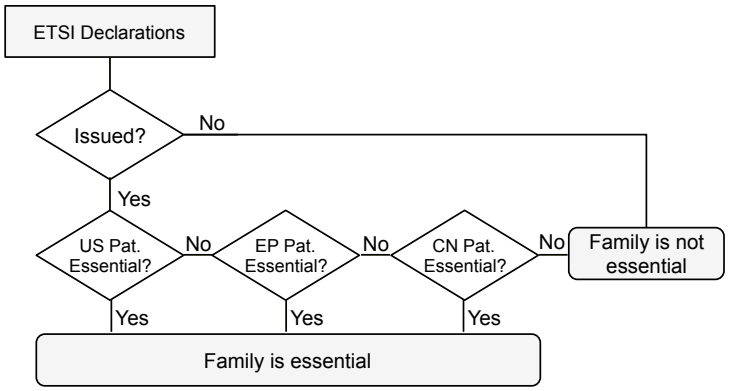

Figure 13 - Fairfield Resources methodology

4.1.1.1 Selection of studied patents

The starting point for the study was to analyze the patents that had been declared essential to LTE and SAE as of July 1, 2009. According to the report, 1115 issued patents and patent applications were declared essential at that point. However, no information is revealed on how the methodology finds the declared patents in the ETSI IPR database. A couple of limiting filters were applied to the original sample:[7]

- The first criteria were to only review the issued patents. Each declared application was reviewed to determine whether the patent was issued or not.
- The second step was to group the issued patents into patent families, meaning that patents with the same priority number were grouped together using the INPADOC database.
- Only patent families containing issued US, EP or Chinese patents were analyzed

After the filtering was conducted, 210 patent families were further analyzed to determine whether the patents were essential to the standard or not. It is not disclosed how big share of the original patent population that was included in the 210 families.

4.1.1.2 Analysis process

The next step in the process was to analyze if the 210 families were essential to the standard or not. The patents were analyzed and compared with Release 8 of the technical specification that is released by 3GPP.[8] The assessment of the patents was based on an interpretation of the independent claims. The expert compared the patent claims with the technical specification and evaluated whether the patent mapped on the standard and if it could be seen essential to the standard or not. The average time per patent was one hour.[9]

The assessment of "essentiality" was conducted on a patent family level. This means that one patent from each family was evaluated. If the patent was assessed to be essential, the whole patent family was said to be essential. In general, the latest issued US patent in the family was selected for the analysis. If there were no issued US patent in the family, the

[7] Interview with Robert A. Myers on February 9, 2012
[8] Review of patents declared as essential to LTE and SAE (4G Wireless standards) through June 30, 2009
[9] Interview with Robert A. Myers on February 9, 2012

latest EP patent was selected. If there were no European Patent in the family, the latest issued Chinese patent was selected for analysis.

The reason behind analyzing the Chinese patents in the patent family was that the team that conducted the analysis included analysts with knowledge in the Chinese language. In previous studies they included Japanese patents that was translated to English. However, the translations caused problems for the analysts and the team decided to not include Japanese patents in the study.[10]

If the analyzed patent was assessed to be essential, the whole family was considered to be essential. However, if the analyzed patent was not assessed to be essential, the analysis continued with the second latest issued patent. This process continued until a patent in the family was assessed essential or until all US, European and Chinese patents in the family had been assessed to not being essential. The reasoning behind the above mentioned procedure is that the team did not want to miss a potentially essential patent by just analyzing a single patent and consider its family not essential based on the assessment of that single patent.[11]

Table 4 summarizes the indicators that are used by Fairfield. The methodology counts patent families that are assessed to be essential to the standard based on a technology mapping. The analysis only considers if the patent claims map on the technical standard specification and does not consider any types of patent data.

Indicator	Used in methodology
Citations	No
Number of patents	Yes
Claim characteristics	No
Prosecution time	No
Geographical scope	No
Technology mapping	Yes

Table 4 - Indicators used by Fairfield

4.1.2 THOMSON REUTERS

Thomson Reuters has, in collaboration with Article One, released a study of the patents declared to LTE, illustrated in Figure 14. The team at Thomson Reuters has long experience of mapping patents to products and technical standard specifications. The team consisted of eight analysts with a background in electronics and radio communication. They were familiar with the standard and the LTE technology before the study.[12]

[10] Interview with Robert A. Myers on February 9, 2012
[11] Interview with Robert A. Myers on February 9, 2012
[12] Interview with Sachin Sinha on March 21, 2012

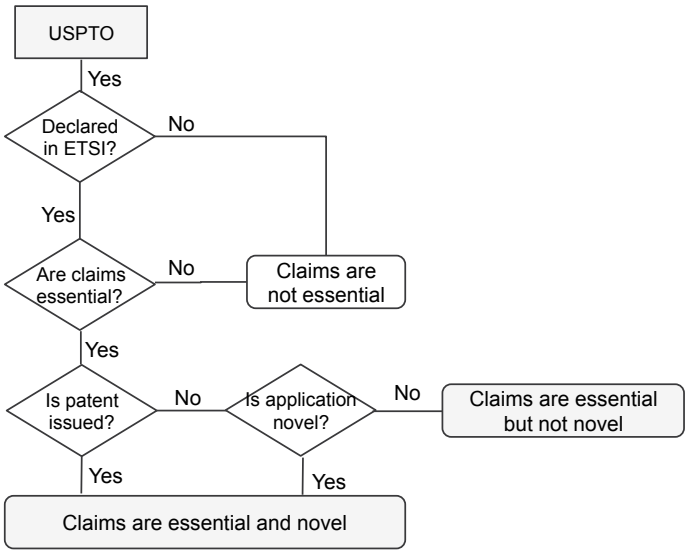

Figure 14 - Thomson Reuter's methodology

4.1.2.1 Selection of studied patents

The study included the patents declared essential to LTE as of September 30, 2011. The client selected the reviewed population and Thomson Reuters did not influence the selection. The study included both issued patents and published applications. The reasoning behind this was that the pending applications give insights in the future patent landscape. The original population contained 3116 patents of which about 40 percent were issued patents[13].

Thomson Reuters decided to only review US patents and applications to reach conformity in the analysis. They also pre-screened the patents and sorted out irrelevant patents based on the title of the patent or patent application[14].

4.1.2.2 Analysis process

The patents and patent applications were assessed on an individual level were each patent was analyzed. The first step was to identify the broadest independent claim in the patent. The latest published claims were used for patent applications. The next step was to find the correct part of the technical specification. For some patents this information was disclosed in the ETSI IPR database. When this was the case, the team started to evaluate the patent against the disclosed technical specification. If no specification was disclosed, or if the information was incorrect, keywords from the patent was used to identify the possible specifications.

The claims were then compared with the standard specification and the patent was assessed to be essential to the standard or not. When the claims were compared to the standard specification, the expert assessed if the patent mapped on the standard, either explicitly or implicitly. If the claim and the technical specification contained essentially the same text the

[13] Interview with Sachin Sinha on March 21, 2012
[14] ibid

patent was said to map explicitly. If the elements of the claim and the concept of the specification mapped the patent was said to map implicitly.[15]

The next step of the analysis was to analyze the level of novelty for the patent applications that was assessed to be essential to the standard. This step was done to give a more nuanced view of the future patent landscape. The analysis of novelty was used as a filter with the end result being a set of patent applications that was assessed to be essential and to have a high degree of novelty.

The analysis of the novelty was done through reviewing the prior art references. Both references cited by the patent office as well as by the applicant were reviewed. The review aimed to analyze if the patent application was novel compared to what is stated as the state of the art.

Table 5 summarizes the indicators used by Thomson Reuters. The methodology counts patents and patent applications that are assessed to be essential to the standard specification based on a technology mapping and do not use paten data in the analysis. The novelty check for the applications functions as a filter in the count of essential patents and patent applications.

Indicator	Used in methodology
Citations	No
Number of patents	Yes
Claim characteristics	No
Prosecution time	No
Geographical scope	No
Technology mapping	Yes

Table 5 - Indicators used by Thomson Reuters

4.1.3 TECH IPM

Tech IPM, a small IP consulting firm, has released a series of patent portfolio benchmarks of companies possessing patents related to the LTE technology. One single man, Alex G. Lee, who also is the Managing Director of Tech IPM, compiles the studies and uses the methodology illustrated in Figure 15. While other benchmarks try to capture the LTE technology in general, Tech IPM have chosen to only focus on one technical area, Radio Access Networks. The reason behind this is that Alex G. Lee has a background in this technical field and he claims to have the knowledge to assess patents concerning this technology but not other technical areas of the standard.[16]

[15] Interview with Sachin Sinha on March 21, 2012
[16] Interview with Alex G. Lee on February 10, 2012

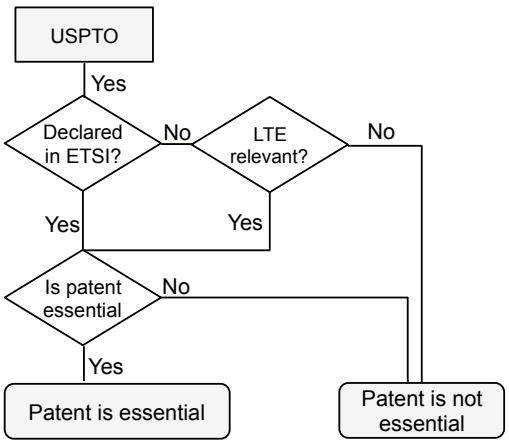

Figure 15 - Tech IPM Methodology

4.1.3.1 Selection of studied patents

The population consisted of both issued patents and published applications. Only US patents and applications were considered in the study Tech IPM uses both the ETSI IPR database and keyword searches to find patents that could potentially be relevant for the RAN area. 80 percent of the patents that was reviewed came from the ETSI database while the other 20 percent was identified using keyword searchers. The idea behind combining the ETSI IPR database with keyword searches is that the keyword search enables Tech IPM to identify patents from companies that does not intend to license their patents under the FRAND commitment.

4.1.3.2 Analysis process

The indicators used by Tech IPM are summarized in Table 6. Tech IPM compares the patents and applications to the standard specification to assess whether the patent is essential or not. The assessment is based on how well the claims of the patent conform to the technical specification.[17] Patent data is not used in the analysis.

Indicator	Used in methodology
Citations	No
Number of patents	Yes
Claim characteristics	No
Prosecution time	No
Geographical scope	No
Technology mapping	Yes

Table 6 - Indicators used by Tech IPM

4.1.4 PATENT PIPELINE POWER

Patent Pipeline Power is an annual ranking that is published in the journal IEEE Spectrum. The analysis is performed by 1790 Analytics.[18] The ranking is a combination of patent count and citation metrics as shown in Figure 16. Patent pipeline power compares companies from the same industry and the citation metrics for each patent is calculated based on a comparison with patents from the same technology class.

[17] ibid
[1818] Source: http://spectrum.ieee.org/at-work/innovation/patent-prowess/3 *(available: May 20,2012)*

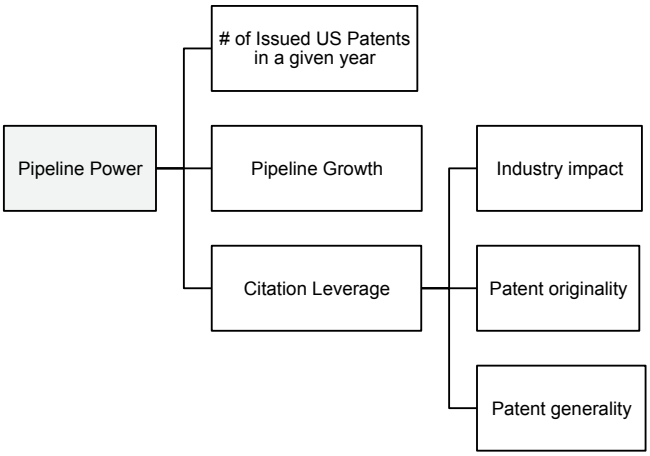

Figure 16 - Patent Pipeline Power Methodology

4.1.4.1 Patent count

Patenting frequency is measured using two metrics that describes the patenting activities of the companies. The focus is on what patenting activities that has taken place during the last year, which can be explained by the fact that the ranking is released annually and which enables year-to-year comparison. The two metrics that are used to measure patenting frequency is the number of issued US patents during the last 12 months period and the growth rate of the patent portfolio.[19]

Patent Pipeline Power counts the number of issued US patents during the last year to reflect the size of the companies' patenting activities. This means that companies that get many patents issued get a higher score on this metric. This metric will of course favor companies with a large patent organization. The metric will also favor companies that are active on the US market since only US patents are taken into account.

The other metric that is used to reflect patenting frequency is the growth rate of issued patents. The number of issued patents is compared with the average number of issued patents during the preceding 5 years. A company that has 125 patents issued this years and an average of 100 patents issued during the preceding five years will get a growth rate of 1.25. Companies with a patent portfolio that is growing exponentially will get a higher score than a company that has more or less the same number of issued patents every year. Also, companies with smaller patent organizations are compensated if their activities are increasing.

4.1.4.2 Citation-based metrics

Patent Pipeline Power uses citation analysis to determine the impact and quality of a company's patent portfolio. Three citation-based metrics are used: Industry impact, Patent Generality and Patent Originality. The metrics are constructed by comparing each patent with the average score for patents in the same technology class and that are issued during

[19] http://spectrum.ieee.org/computing/hardware/patent-power/0 *(Available: May 20, 2012)*

the same year. The average score is given a normalized score of 1.0 and companies that receives a higher score gets a normalized score above 1.0.[20]

Industry impact measures how many patents that cite patents in a company's patent portfolio. The metric is calculated using all patents that are issued during the analyzed year as a starting point. All patents that have been cited in any of those patents get a score. The number of citing patents are summarized for all patents and then compared with all other patents in the same technology class that are issued during the same year as that patent. The average score for all the patents in the portfolio that have been cited then gives the company score. High rates of self-citations are penalized in the industry impact metric. The reason for this is that a high number of self-citations is a measure for the patent's impact internally rather than externally in the industry.[21]

The Patent Pipeline Power also rewards patents that cover inventions with many application areas through the metric Patent Generality. Patents that have been cited by subsequent patents in many different technology classes are awarded points for Patent Generality. The number of unique technology classes are summarized for each patent and compared with the average number of unique technology classes for all patents in the same technology class issued during the same year.[22]

The third metric is called Patent Originality. The assumption for this metric is that patents that cite earlier patents from different technology classes are more original than patents that cite preceding patents from the same technology class. To get the Patent Originality score the number of unique technology classes of the cited patents are counted and compared with the average for patents in the same technology class issued in the same year.[23]

Table 7 summarizes the indicators used in Patent Pipeline Power. The methodology is centered around citations and portfolio size and growth. The patent scope is not assessed in the methodology.

Indicator	Used in methodology
Citations	Yes
Number of patents	Yes
Claim characteristics	No
Prosecution time	No
Geographical scope	No
Technology mapping	No

Table 7 - Indicators used in Patent Pipeline Power

4.1.5 IPQ Score

The patent analytics firm OceanTomo has developed a proprietary method to rank patents. The idea behind the method is that more valuable patents are more likely to be maintained than less valuable patents. OceanTomo has developed a regression model that uses several

[20] http://spectrum.ieee.org/computing/hardware/patent-power/0 *(Available: May 20, 2012)*
[21] ibid
[22] ibid
[23] ibid

patent data metrics to evaluate whether the patent is likely to be maintained or not. Since the method is proprietary and even patented[24] it has not been possible to identify all the metrics that the model takes into account and even less how the different variables are weighted in the regression model. The IPQ score ranks each patent's quality on a normalized scale with a median of 100. Patents with an IPQ score above 100 are more likely than the median patent to be maintained.[25]

The IPQ score can also be used to measure the patent portfolio quality by aggregating the scores for each individual patent. The average IPQ score for patents in the portfolio then gives the portfolio IPQ score. The portfolio IPQ score can be used to compare the portfolios of different companies. However, one should be aware that the size of the portfolio is not reflected in the portfolio IPQ score. Hence, companies with large patent portfolios can get lower portfolio IPQ scores just because they have many patents in their portfolio.[26]

Table 8 summarizes the indicators used in IPQ Score. The methodology uses a set of indicators based on patent data to benchmark portfolios. The technology scope of the patents is not considered in the methodology and neither is the size of the patent portfolio[27].

Indicator	Used in methodology
Citations	Yes
Number of patents	No
Claim characteristics	Yes
Prosecution time	Yes
Geographical scope	Yes
Technology mapping	No

Table 8 - Indicators used in IPQ Score

4.2 PATENT DATA EXPERIMENT

A set of patents has been analyzed to evaluate the relation, if there exist one, between strength indicated by citations and an internally assessed relevance classification done by the holder of the patents. To support the case study and further understand the nature of citations we have also investigated how the patent examiner decides upon making a reference.

Both the previous literature and the studied benchmark methodologies indicate that citation analysis is widely used when evaluating patent portfolios. Hence, this experiment is focused on the relation between the patent portfolio's citation data and the, by Ericsson, assessed relevance.

A portfolio of patents relevant to the same telecom technology has been analyzed. By using an internal classification of patents, two portfolios were created, one being of higher

[24] See US Patent US6556992
[25] http://www.oceantomo.com/ratings/about/ipq *(Available: May 20, 2012)*
[26] Interview with Elvir Causevic on March 7, 2012
[27] It should be noted that the IPQ score can be used in combination with other measures such as the size of the patent portfolio. When this is done IPQ score and portfolio size are treated as independent variables and the size of the portfolio does not influence the IPQ score for the portfolio. (Source: Interview with Elvir Causevic on March 7, 2012)

relevance than the other. The internal classification system's purpose is to help the patent manager to allocate economic resources to the most important patents. The advancements in research and development and the increasingly intense patenting activity in the telecom area makes it hard to economically motivate evenly distributed economic effort on all patents. The relevance classification is a tool for putting patents into groups where a portfolio manager easier can identify, which patents that should be prioritized. This means that a patent with high relevance has a higher possibility to be or in the future become part of a licensing deal since more effort will be put into maintaining and developing that patent into producing licensing revenue. On the other hand, a patent ranked as "Low" may also be part of a future licensing deal since the relevance classification is an iterative process that re-assess the relevance for each patent on regular basis.

More information about each relevance criteria can be found in Appendix III

4.2.1 RESULTS

The basis of the analysis has been to investigate the relation between the quantitative measure of citations and the internal relevance classification used within a company.

In average the data set had an average of 3,2 citations. However, in order to make the citation data comparable the number of citations needs to be adjusted for the time the patents have been available to be cited. This time as been approximated to 18 months after application to the time when the data was extracted (2012-03-01).

Looking the two analyzed portfolios, the highest average number of citations per year could be found in the portfolio with the highest relevance classification, "High". Here the average number of citations reached 0.51 per year as a publically available patent.

Patent portfolio	Number of patents	Total Number of Citations	Average Number of Citations per year	Average age
High	41	218	0.51	8.30
Low	293	853	0.31	6.86
All	334	1071	0.33	7.04

Figure 17 - Number of patents, number of citations, average number of citations per year and average age for both portfolios.

A closer look into the two portfolios shows the distribution of number of citations in the whole population of each portfolio. This shows that a large portion of the respective portfolios actually hasn't received any citations at all. Of patents found in the High relevance portfolio, 34 % hasn't received any citations at all and for patent found in the Low relevance portfolio 50 % hasn't received any citations at all.

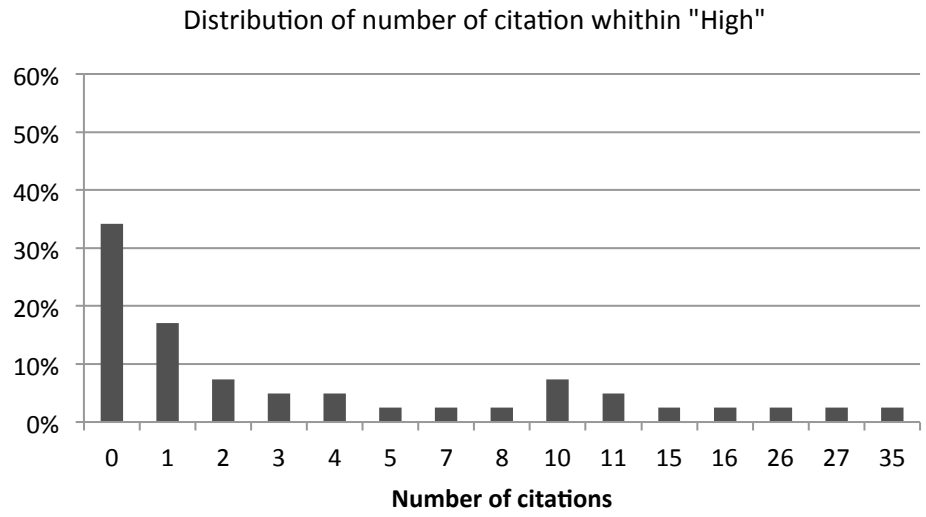

Figure 18 - Distribution of number of citations per patent within High

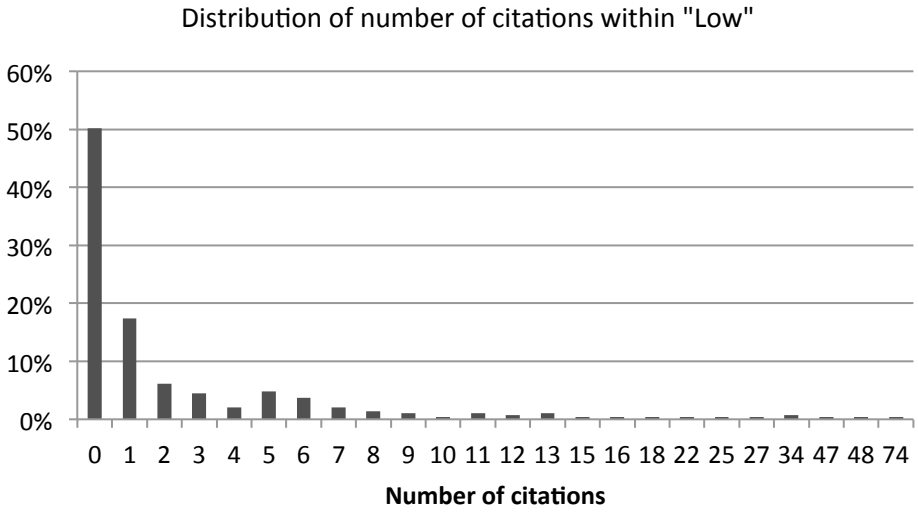

Figure 19 - Distribution of number of citations per patent within Low

5 DISCUSSION

This section will discuss the empirical data in relation to the research questions that have been defined for this thesis. The discussion is structured in the way that the data from the case study is discussed in relation to the first two research questions and the data from the empirical data is discussed in relation to the third research question. The discussion in this section is the basis for the conclusions presented in Section 6 where the main research question of the thesis will be answered.

5.1 DISCUSSION ON CASE STUDY

As described in Section 3.1, the literature discusses patent analysis as a tool or activity that can be used with multiple purposes. The focus of the analysis can be both to get a better view of the company's internal assets and to get a better picture of the company's external environment.

The theoretical framework is used to support the analysis of the empirical data. The aim with the analysis is to categorize the studied methodologies depending on how they are constructed. The literature review shows that there exist two approaches for analyzing patents and patent portfolios. The first approach involves using indicators based on patent data and the other approach, technology mapping, involves assessment of patents against a specific product or in this case, standard specification.

As discussed by Davis & Harrison (2001) this type of analysis can be used to obtain information about the company's environment and competitors. Figure 20 shows examples of questions that can be targeted by performing this type of analysis. As will be discussed further, the studied benchmarking methodologies may not shed light to all of the above stated questions but all of the studied methodologies support the understanding of at least one of the questions below.

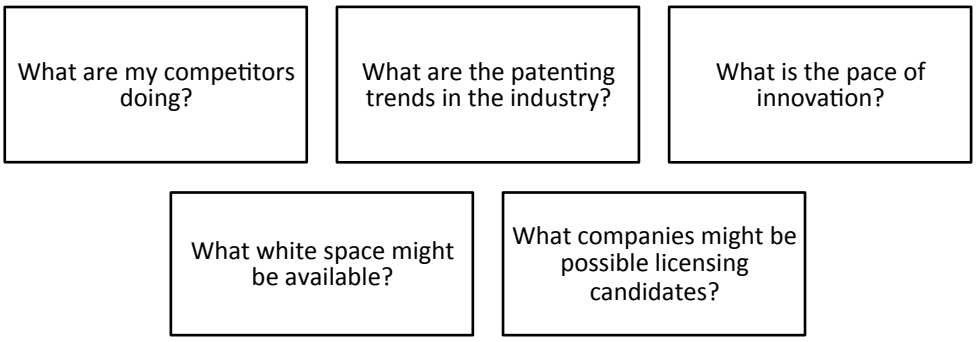

Figure 20 - Questions possible to target with an analysis of the competitors

The concept of Patent value is discussed by Gregory (2007) (See section 3.3) The discussion in the literature is that patents can be valued from different perspectives. Figure 21 illustrates different aspects of patent value that can be considered. By looking at Gregory (2007), four value adding activities we will discuss which aspect that is captured in the methodologies. Since patent value can be represented by such a wide range of activities we can expect that none of the methodologies will capture all perspectives of patent value.

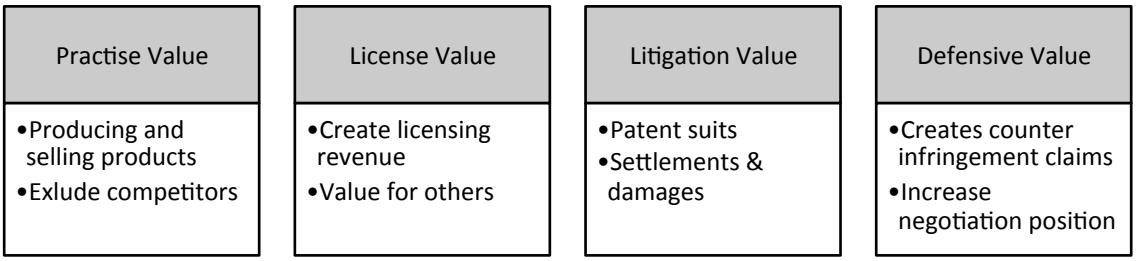

Figure 21 - Different perspectives of patent value

5.1.1 CATEGORIZATION OF STUDIED METHODOLOGIES

All the methodologies that have been studied for this thesis look at the patent portfolio of different actors in the telecom industry with the purpose to compare the different actors potential of capturing value by using the patent portfolio.

Methodology	Scope of analysis	Citat-ions	Number of patents	Claim characteristics	Prosecution time	Geographical scope	Technology mapping
Fairfield Resources	LTE-related patents	No	Yes	No	No	No	Yes
Tech IPM	RAN-related patents	No	Yes	No	No	No	Yes
Thomson Reuters	LTE-Related patents	No	Yes	No	No	No	Yes
Patent Pipeline power	US patents granted in a given year	Yes	Yes	No	No	No	No
IPQ Score	US Patents	Yes	No	Yes	Yes	Yes	No

One differentiating factor is the approach that is used to conduct the analysis, see Figure 22. While IPQ Score and Patent Pipeline Power uses different sets of indicators to analyze the patent portfolios, the other methodologies uses technology mapping. It is easy to understand that using different approaches will influence the way the result of the studies can be interpreted and what type of conclusions that can be drawn from the analysis.

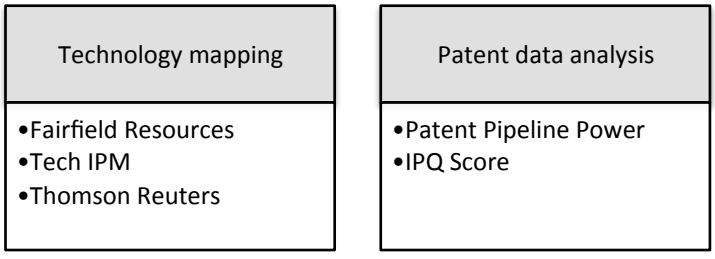

Figure 22 - Approach of analysis

Another factor that differentiates the studied methodologies is the breadth of technological scope that has been included in the analysis, see Figure 23. Fairfield, Tech IPM and Thomson Reuters limits their analysis to only analyze patents in relation to the technology that is defined by the LTE standard. IPQ Score and Patent Pipeline Power do not relate the analysis

to a limited technology area but tries to capture the "general" strength of the companies' patent portfolios.

Technology Specific	General
•Fairfield Resources •Tech IPM •Thomson Reuters	•Patent Pipeline Power •IPQ Score

Figure 23 - Technological scope

The two differentiating factors that have been discussed above can be combined in a 2X2-matrix, see Figure 24. This matrix shows that the studied methodologies essentially can be divided into two groups: Technology specific analysis using technology mapping and "General" analysis using indicators based on patent data.

	Patent Data Analysis	Technology Mapping
Technology Specific		Fairfield Resources Tech IPM Thomson Reuters
General	Patent Pipeline Power IPQ-Score	

Figure 24 - Categorization of benchmark methodologies

The matrix in Figure 24 also shows that two of the fields are left blank. It is easy to understand why none of the studied methodologies uses technology mapping to perform a "general" analysis. Doing this is essentially impossible since the idea behind technology mapping is that the patents should be mapped against a defined technology area.

When it comes to the other blank field, the discussion becomes a bit more interesting. Using indicators to analyze a set of patent portfolios that relate to the same defined technology would definitely be possible. However, such an analysis would still end up in the "general" category since using indicators does not make it possible to relate the patents to the defined technology area. The absence of relation to the defined technology can be described by discussing what would happen if the defined technology developed. Such a change would possibly impact the analysis by making single patents more or less relevant for the technology. However, the change in the defined technology area would not be reflected when using indicators since the indicators measure a static phenomenon in relation to the development of technology.

As shown above, the studied methodologies can be categorized in two groups that use different approaches to study patents in different context. The following two sections will discuss the two categories more in depth both from the perspective of which type of questions that the patent portfolio manager will be able to answer with the methodologies and what type of patent value that is captured with the methodology.

5.1.2 Characteristics of Technology specific benchmark methodologies

Benchmarking methodologies that compare portfolios for a specific technology area tend to require a high level of knowledge in the technology area. The studied methodologies map different actors' patent portfolios against the LTE standard specification and the relative position of the companies is determined by the number of patents that are assessed to be essential for the standard.

The mapping against the standard specification can be compared with the mapping of patents against a physical product. However, the fact that a standard specification is a descriptive text document instead of physical attributes and technical features requires a different set of experience for the analyst. The analyst will need to have a combined knowledge of the technology as such but also the skill to interpret the scope of the technical specification. In addition, the analyst needs to be knowledgeable in the patent language but in this case there is no difference compared with a mapping on a physical product.

5.1.2.1 Questions targeted by the methodologies

The technology specific methodologies are used to bring clarity in the patent landscape of standard essential patents for the LTE technology. The result of the analysis is typically a chart that states that company A holds X essential patents while company B holds Y patents. Looking at the questions in Figure 20, this type of analysis helps the patent portfolio manager to understand what the competitors are doing in this technology area. The analysis can also work as a starting point for analysis of potential licensing targets, see Figure 25.

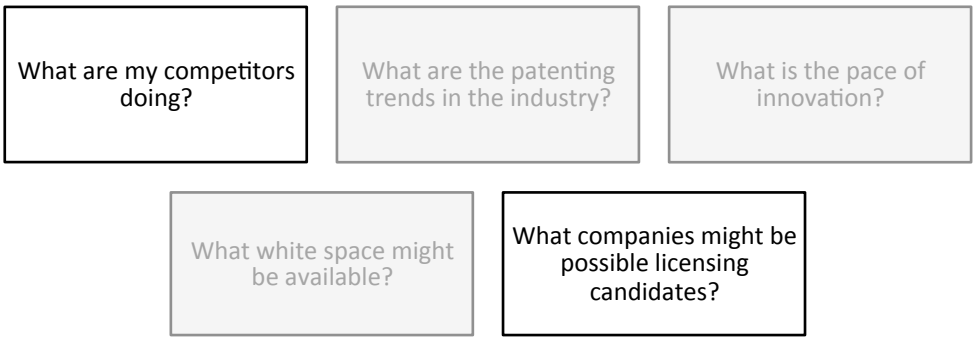

Figure 25 – Questions targeted with technology specific methodologies

By analyzing which competitors that hold essential patents, the company will add information to their understanding of the competitive landscape. The analysis will give the company a snapshot of what the competitors hold in terms of essential patents. It will be possible to conclude which actors that might be potential competitors and to rank them on the basis of how many essential patents they hold.

The second question that can be addressed with this type of analysis is closely related to the first one. Since telecom standards are built on open innovation, the actors that hold essential patents are obliged to license the patents under FRAND terms. By using this type of analysis the patent portfolio manager will add information that can help them to prioritize which other actors they need find cross-licensing agreements with. However, the analysis of potential licensees requires a lot more information than this type of analysis can produce.

The questions that are not addressed by this type of analysis require an analysis on a more aggregate level. These methodologies only take a snapshot of the situation at a given point in time. To be able to analyze patenting trends and patterns, time is an important variable that needs to be taken into consideration. A possible way to include the time aspect in the analysis would be to regularly iterate the methodology and focus the analysis on the changes in the landscape since the latest analysis. However, that approach would be very resource and time demanding considering the complexity of the analysis.

5.1.2.2 Captured perspectives of patent value

The patent value adding activities framework, as proposed by Gans et al (2003), can be used to describe what aspects of the patent portfolio that has been captured by the benchmark. The technology specific benchmarks investigated in this study relates to LTE, a standardized technology. This means that the main revenue driver for these portfolios is through license. The first step of the technology specific benchmark methodologies is to define a patent population that cover all the LTE related patents and then determine the essentiality of those. The outcome of this is a percentage for each company's share of standard essential patents. Hytönen et al's (2011) principle of proportionality describes that the royalty rate is often proportional to the company's share of total technological value. This, in combination with the characteristics of the specific benchmarking methodologies, shows that the technology specific benchmark methodologies indirectly capture some of the license value in the patent portfolio, see Figure 26.

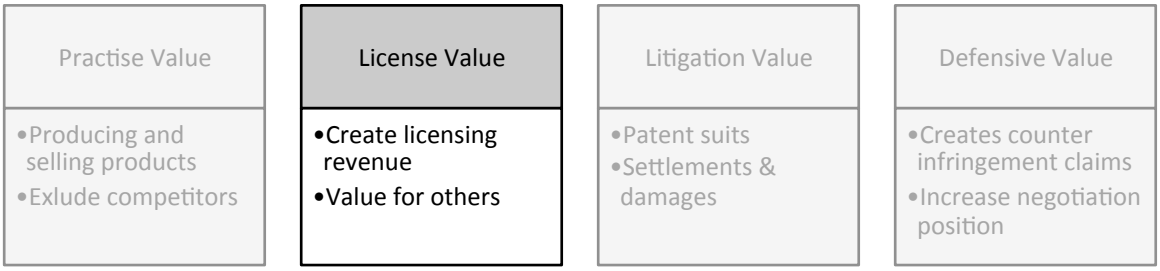

Figure 26 - Different kinds of private value, source: (Gans & Stern, 2003)

5.1.3 CHARACTERISTICS OF GENERAL BENCHMARK METHODOLOGIES

While the technology specific benchmark methodologies focused on one particular technology area the general benchmark methodologies looks at and compares a wider set of a company's patent portfolio to determine the importance of the patent portfolio relative the patent portfolios of the company's competitors. Citation data and other quantitative patent data are used to evaluate patent portfolios.

The studied general benchmark methodologies are both based on issued US patents. While the IPQ score takes all granted and active patents into account, Patent pipeline power only considers patents issued during the past year. This difference gives the two methodologies different characteristics. Patent pipeline power is better at fetching changes in the relative positioning of the actors while the IPQ score rather gives a more static picture of the landscape.

General benchmark methodologies have a higher degree of automation compared with technology specific benchmark methodologies. The reason for this is that the general methodologies only look at quantitative data that is relatively easy to analyze using computers. Technology specific benchmark methodologies require an interpretation of the patent claims to assess if the patent maps on the technology. This activity can only be done by a human and thus requires more man-hours.

The general benchmarking methodologies uses the approach “mine every piece of dirt”. The approach is possible thanks to the high degree of automation and it also supports the purpose of identifying important actors. To only look at parts of the patent portfolio would imply a risk of skewed results. Hence, it is better to include patents from all possible technology areas.

5.1.3.1 Questions targeted by the methodologies

This type of analysis is not granular enough to give an understanding of which actor that is strong in a certain technology but it can give a hint on the relative strength of the portfolio in a long-term perspective, see Figure 27. An important factor to consider for the general benchmark methodologies is that the linkage to the business context is very weak. Studying citations of a patent does not give any information about the patents relevance for a specific technology. Rather than giving detailed information on each actor in industry, this type of analysis can be used to identify patterns on innovation and patenting.

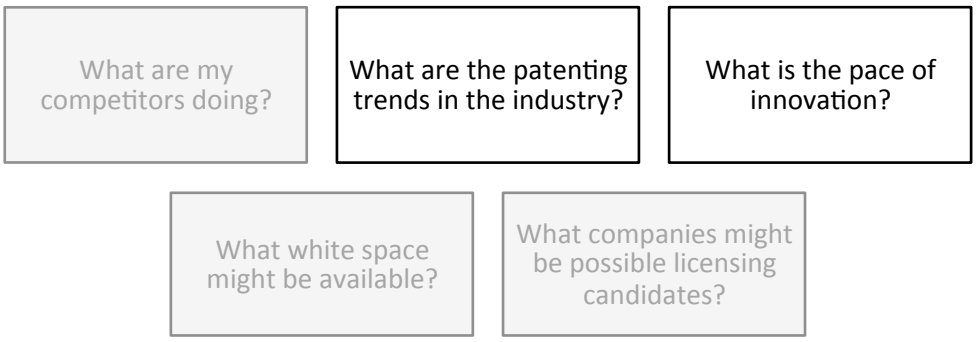

Figure 27 - Questions targeted with "general" methodologies

The “General” methodologies use indicators based on patent data to analyze the industry. The relatively high level of automation in the analysis makes it easy to iterate the analysis, which will open for an analysis of trends that are time-dependent. By using patent count and growth rates, the portfolio manager will be able to see if a potential competitor is changing direction of their patenting strategy.

Another way to use this type of analysis is to look at the industry as a whole. By combining the numbers of all the included actors it is possible to get an understanding of the pace of innovation. Once again, time will be an important factor to consider, The "general" methodologies does not consider context which is why this type of analysis will not be able to tell if the industry is moving towards a particular technology area.

5.1.3.2 Captured perspectives of Patent value

As mentioned above, the linkage to business context is very weak for the general methodologies. This makes it hard hard to assign the captured value to any of the value categories proposed by Gans et al. (2003). Since the technology context is not defined and instead analysze the complete portoflio of patents the value captured can be said to vary from case to case depending on how the portfolio is used. This means that the general studies try to measure a generic kind of value independent of usage or field of technology. As described by Gregory (2007) this is a common case for existing patent benchmark methodologies.

5.1.4 ADVANTAGES AND DISADVANTAGES WITH THE STUDIED METHODOLOGIES

While section 5.1 discussed the two categories of patent benchmarks that have been identified in this study, this chapter will look at the methodologies more in detail. The methodologies that are used when conducting a patent benchmarking study is important in the way that it is a representation of the choices the analysts make in order to define the purpose of the study. The methodologies will be discussed in relation to their position in the matrix presented in Figure 24 since comparing the methodology of a general benchmark with a technology specific benchmark would be to compare apples and pears.

5.1.4.1 Technology specific benchmarking methodologies

The technology specific benchmarking methodologies that have been included in this thesis have some differences in the way the analysis is set up that may influence the results of the analysis. All the included methodologies include a technology mapping where an analyst compares the claims of the patents with the technical specification of the 3GPP standard. The aim is to assess if the patent scope covers the technical specification and thus if the patent is essential to the standard or not.

As discussed in Section 3.2.2 this technology mapping is based on the opinion of the analysts. This report does not aim to question or analyze the analyst's knowledge in the LTE technology and thus will the technology mapping not be further discussed in this report. It is also assumed that the mapping is done correctly and unbiased. Instead, the focus of this discussion will be the steps in the methodology that defines the population of patents that are subject for the technology mapping, see Table 9.

	Included patent population	Filters
Fairfield Resources	• Patents declared in ETSI	• Group patent families • Only include Issued patents
Thomson Reuters	• Patents declared in ETSI	• Only US patents
TechIPM	• Keyword search and patents declared in ETSI	• Only US patents

Table 9 - Elements that differentiate the technology specific benchmark methodologies

As shown in Table 9, the methodologies have some elements that differentiate the methodologies from the others. The differentiating elements impact the benchmarking studies primarily by defining the patent population that will be included in the analysis. When discussing the elements it is important to also look at the purpose of the study. As discussed by Petrusson (2004) it is often the case to look at patents as stand-alone objects when performing this kind of studies.

For the studies in Table 9, the purpose is to analyze how many patents each actor possesses that can be mapped on the technical specification for the 3GPP standard LTE. With this in mind it is possible to discuss the impact of the existence or inexistence of the elements.

5.1.4.1.1 Elements that defines the patent population

The first elements to discuss are the starting criteria that are used to generate a list of patents that should be included in the analysis. The methodologies that have been studied in this thesis have essentially two types of starting criteria, either to perform keyword searches or to only include patents that are declared in the ETSI IPR database. The advantages and disadvantages for these elements are summarized in Table 10

	Advantages	Disadvantages
ETSI Declarations	• More narrow starting point than keyword search • Guaranteed to find essential patents in the population	• Might exist patents that have not yet become declared that are essential for the standard
Keyword search	• Possible to capture relevant patents that have not been declared to ETSI	• Results may include many irrelevant patents • No guarantee that essential patents are included in population

Table 10 – Elements that defines the patent population

For a standardized technology like LTE, the ETSI IPR database may seem like a natural starting point to define a population of patents to include in the analysis. The idea with the database is to increase the transparency of the standard essential patents and by limiting the scope of the patent population to the declared patents the analyst will have a more narrow scope of analysis compared to keyword searches. The analyst will also be certain that the population will include patents that are considered to be essential by the declaring company.

Keyword searches are perhaps more common for technologies that are not standardized and hence lack a database of essential patents. However, keyword searches can be used for standardized technologies like LTE as well. Compared with using the ETSI database, keyword searches implies that patents held by companies not part-taking in the standardization process of 3GPP may be included in the analysis. The size of the population of patents is heavily dependent on the search strategies that are set up. Most important is that keyword searches do not guarantee that the essential patents are included in the population created by keyword search.

5.1.4.1.2 Elements that limits the patent population

Regardless if ETSI declarations or keyword searches are used to define the population of patents to analyze, further limitation of the analysis can be done by adding filtering elements to the methodology, see Table 11. These elements are often applied to reach conformity in the data (patents) that are to be analyzed. These filtering elements are not mutually exclusive and a combination of filters can potentially be used. The elements that have been identified in the studied methodologies are: only include US patents, include patent applications and to group patents in patent families.

	Advantages	**Disadvantages**
Only include US patents	• Conformity of data • Most companies file patents in the US due to importance of market	• Only focus on one market
Include patent applications	• Gives an indication of future state • Includes companies that started to file patents later	• Applications are living documents and the scope of protection may change during prosecution • Not all applications result in issued patents
Group in patent families	• Reduces amount of analysis. • More focus on technology than patents	• Might give skewed results due to large patent families

Table 11 - Limiting elements

With telecom being a truly global industry it might be odd to only look at US patents as some of the studied methodologies does. However, the importance of the US market makes it a highly prioritized jurisdiction to file for patents in[28]. This means that looking at only US patents may not be limiting in the sense that crucial actors will be excluded from the analysis. However, a company's position in such a benchmarks should not be interpreted as their global position. The advantages with only looking at US patents are that the amount of redundant information is reduced and the conformity of the data makes the analysis less demanding.

Fairfield Resources excluded patent applications in their study while Thomson Reuters and TechIPM included patent applications. The scope of the analysis will change slightly depending on whether applications are included or not. The inclusion of applications gives

[28] Interview with Monica Magnusson February 3, 2012

an indication of a future state. However, a problem occurs when issued patents and patent applications are treated and valued equally. It is important to remember that patent applications are living documents and that the scope of protection may change during the prosecution.

A third limiting element is to group patents into patent families based on the invention that the patents are covering. This element can be good in the same way as to only include US patents; it reduces the amount of redundancy in the data. However, patent family data can be unreliable and there is a risk that one patent family includes many inventions, which will result in a skewed result.

5.1.4.2 General benchmark methodologies

The general benchmark methodologies do have some elements that differentiate them from each other. When looking at the methodologies it becomes clear that the focus of the methodologies is different even if they are both general benchmark methodologies. The elements, summarized in Table 12, influences the studied population of patents as well as how different types of patent data are accounted for in the methodology

	Included patent population	Account for portfolio size	Other factors than citations	Scoring system
Patent Pipeline Power	• US patents issued during the past 12 months	• Yes	• Portfolio growth	• Mix of absolute and relative ranking
IPQ Score	• All issued and active US patents	• No	• Yes, patent data, e.g claim length and number of claims	• Relative ranking

Table 12 - Elements that differentiate general benchmarking methodologies

The common factor for the general patent benchmarking methodologies is that they do not analyze the patent portfolios in relation to a specific technology. Instead, they use different types of patent data to analyze the importance of the patents in each company's portfolio. The two methodologies that have been included in the study do this in quite different ways. The first difference that have been identified is how the population of included patents is defined. As seen in Table 12, Patent Pipeline power includes only US patents that were issued during the past 12 months while IPQ Score includes all valid US patents that the company possesses. This difference gives the methodologies different character and the advantages and disadvantages are summarized in Table 13.

	Advantages	Disadvantages
Include only patents issued during the past 12 months	• Captures development of technology	• Does not capture accumulated strength of portfolio
Account for portfolio growth	• Captures smaller actors increasing activities	• Too large focus on quantity of patents
Account for size of portfolio	• Captures power of larger actors	• Too large focus on quantity of patents
Use absolute ranking	• Gives information about actual portfolio strength	• May be difficult to compare companies
Use relative ranking	• Easy to compare companies from different industries	• No information about actual strength

Table 13 - Advantages and disadvantages with element in general benchmark methodologies

To only include patents that have been issued during the past year gives the methodology a character of capturing the development rather than the accumulated portfolio strength. If the analyst wants to get a full picture of the patent situation it is important to include all patents in the portfolio since patents that where issued a few years ago may still have a huge importance for the technology development.

Two other elements that can be discussed are if metrics for portfolio size and portfolio growth should be used. When used, these elements may imply that the focus of the methodology turns into a quantitative exercise where numbers of patents become important. However, both these elements describes the state of the patent holder and when used in combination, portfolio growth will give an advantage to companies with emerging portfolios while portfolio size gives an advantage to companies with mature patent portfolios.

Lastly, the scoring system of the benchmarking methodologies can be discussed. The two studies are either using a relative scoring system or a mix of absolute and relative scoring. The relative scoring has the advantage that it is easy to compare companies from different industries while an absolute ranking is better when analyzing companies within the same industry. Both types of ranking system can of course be used but it is once again important to remember what the purpose of the methodology is when deciding how to construct the scoring system.

5.2 DISCUSSION ON PATENT DATA EXPERIMENT

By applying the theoretical framework on the data presented in 4.2.1 an analysis can be conducted. The results from the patent data experiment has been analyzed with focus on answering research question nr 3, “How can companies use patent data to support the internal evaluation of their patent portfolio?”

5.2.1 THE RELATION BETWEEN PATENT DATA AND CONTEXUAL ASSSESSED RELEVANCE

As indicated in the results chapter for the case study some relation exists between the amount of citations and the internal assessed relevance of a patent. But the question is how this relation should be interpreted and even more interesting; used in practice. Since the relevance classification includes several assessment criteria it can be expected that this

relevance should reflect a somewhat correct picture of relevance for the company's business.

A comparison between the two portfolios reveals that the relevance also is reflected in the average number of citation per year. But when further investigating the distribution of citations within each group we discover that the majority of patents have got no citations at all, see Figure 28. This prevents us from drawing conclusions for an individual patent's potential relevance classification. Instead the distribution of citations in the studied portfolios provides insight of how a citation analysis should be interpreted.

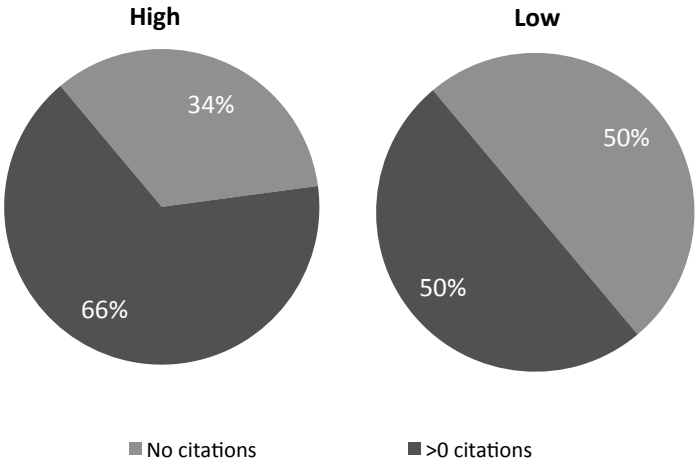

Figure 28 - Percentage of patents without citations in each portfolio

If citations would be able to identify all patents in a portfolio with a high relevance, all high relevance patens should have an average number of citations that is higher than patents in the low relevance portfolio. Our study has showed that this is not the case. A citation analysis cannot identify a single patent's potential to be of high relevance but can be used to compare portfolios against each other on a higher, more generic level.

As described in 3.2.2.2 and showed by Michel et al 2001, the amount of citations a patent has received is highly dependent on the jurisdiction you use when extracting the patent data. This means that even though our analysis has shown average level of citations to be higher in the high relevance portfolio for US patents, this can be expected to differ when looking at patents from other patent offices. However, for our study this would only have an impact if investigated patents has no US patent family member since the citation to one of the non-US family members would count as a citation to the family and thereby also the US patent.

The fact that many patents lack citations can also help us to understand what a citation analysis does not reflect. As argued by Trajtenberg et al (1990), a citation can be seen as a flow of knowledge from one inventor to another and thereby reflects a cited patent's impact on further inventions. However, as with other patent value studies and discussed by Gregory 2007, the value adding activities possible when extracting value from a patent may be very different in nature and require different patent characteristics. These individual characteristics are seldom measured in the analysis methods and even less often represented in a single indicator.

Patent citations can be used as a tool to fast evaluate a patent's or a patent portfolio's impact on the technology development. But to draw conclusions that this indicator would measure any kind of contextual value would be to stretch the conclusions. To create a contextual measure the patent analysis needs to include a direct measure that addresses the value output of such activity, unfortunately this would, as discussed by Gregory 2007, require none disclosed company specific information as well as a significant effort where the analysis ties monetary value to a certain patent.

6 CONCLUSION

This chapter will summarize the findings of the thesis. The thesis has been focused around the research questions and the conclusion aims to answer the main research questions. In addition, managerial implications will be discussed.

The aim with this thesis was to investigate how patent benchmark could be used in patent portfolio management. By analyzing benchmark methodologies and discuss their advantages and disadvantages it has been possible two identify two main types of benchmarks that can be used in different ways; technology specific benchmarks that can be used to identify potential licensing opportunities and general benchmarks that can be used to identify innovation patterns.

Both types of benchmark methodologies can be used to gain information about the environment that a company acts in. The literature refers to this type of analysis as competitive assessments. This type of analysis becomes relevant for companies that have developed a patent organization that aims to be a profit center in the company. The patent organization will then have to look outside its own organization to identify potential threats and opportunities.

The technology specific benchmark methodologies use technology mapping to tie patents to a specific technology, in this case the standardized LTE technology. This type of analysis can give the portfolio manager a good picture of the competitive position of the patent portfolio compared to the competitors' portfolios. This type of analysis requires in-depth knowledge about the technology and can be very costly due to the time that has to be invested in the analysis.

The studied technology specific methodologies are limited to only look at the aspect of technology mapping in the sense that they have compared the patent claims and the technical standard specification. Also, the selection criteria that are used when defining the population of patents that is intended to be studied impacts how the results of the study can be interpreted. An example of such a selection criteria is whether patent applications should be included in the analysis or not. The inclusion of patent applications can be seen as an indication of a future state. However, one should remember that the claims of patent applications often are amended during the prosecution, which can leads to a change of technical scope. Hence, the patent manager has to be more careful when interpreting an analysis that includes patent applications.

The general benchmark methodologies uses patent data, such as citations, to analyze and compare patent portfolios. The level of automation is high and the analysis requires less technology knowledge compared with the technology specific benchmark methodologies. However, the scope of the analysis is also somewhat different since this type of analysis looks at the portfolio as an entity. This type of analysis can be used to analyze the innovation landscape and innovation trends in the industry.

To conclude on competitive positions for the studied portfolios is not a good way to use the general benchmark analysis since that would require a more granular analysis on patent-by-

patent level. The distribution of citations within a portfolio is also very skewed with the vast majority of citations being connected to a very small part of the portfolio. Hence, using citations gives an indication on where to look further but to solely rely on citations would imply a risk of missing potentially strong patents.

A factor that influences how patent benchmark studies should be interpreted is the selection criteria that define the population of studied patents. Regardless if the analyst includes patents on the basis of keyword searches, geographical scope or ETSI declarations it is important to consider which patents that potentially have been omitted from the study and if they potentially can influence the results of the study.

6.1 MANAGERIAL IMPLICATIONS

A patent portfolio manager that wants to know more about the environment the company acts in can use patent portfolio benchmark as a part of the analysis. The manager will need to take the limitations of the benchmark methodologies into account and clearly define what question the analysis is aimed to answer. Only when the question is clearly defined it will be possible for the manager to decide how to construct the methodology.

The patent portfolio manager needs to be aware of the complexity of patents and the business opportunities that a patent portfolio enables. Tools like patent portfolio benchmark will never be able to show the complete and true picture but this type of analysis will support the manager by reducing the uncertainties and to help prioritizing possible actions.

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APPENDIX I - PATENT PORTFOLIO BENCHMARK STUDIES

Name of study: Review of Patents Declared as Essential to LTE and SAE
Company: Fairfield Resources International Inc.
Published: 2010-01-06

Name of study: Emerging Wireless/Mobile Technologies: Patents & Standards for 4G LTE
Company: TechIPM
Published: 1Q 2011

Name of study: LTE Standard Essential Patents Now and in the Future
Company: Thomsson Innovation and Article One
Published: 1Q 2012

Name of study: Patent Power Scorecard
Company: IEEE
Published: 4Q 2011

Name of study: IPQ-score
Company: Ocean Tomo
Published: ongoing

APPENDIX II - INTERVIEWS

Background interviews

Monica Magnusson & Björn Gudmundson Patent Portfolio Manager, Ericsson
Topic: Understanding of how Ericsson is working with patent portfolio strength communication.
Date: 2012-02-03
Duration: 1 hour

Patent Benchmark Interviews

Typical interview questions

1. Can you briefly describe company XX, their business and your role?

a. What was the purpose of the report, how is it used?

2. Can you describe the overall method and the underlying assumptions of why this is a good estimate of essential patents?

3. The report describes the method for deciding the sample of patents as well as the filtering down to where the patents are compared to the standard. We are would like to get a better understanding of how the patents are judged essential and by whom with what background.

a. What is their educational and professional background?

b. If they have different experiences, how is it decided that a certain patent is reviewed by a certain person?

c. Do they have experience in licensing negotiations?

d. How do you deal with patents in areas where you lack the adequate knowledge?

4. Can you describe the reasoning behind considering a family essential if one of the members is found essential? (eg. if a family do not have a member in the US, it will not have significant impact in a negotiation)

5. If they exist, which are the most considerable sources of error?

6. How do think that the result of your report should be interpreted?

7. What is your opinion on other ways of determining a company's fraction of essential patents to the LTE standard?

List of Interviews

Robert Myers, Analyst, Fairfield Resources International
Topic: Understanding the LTE report from FRI.
Date: 2012-02-09
Duration: 1 hour

Alex G Lee, Analyst & Founder, TechIPM
Topic: Understanding the LTE report from TechIPM.
Date: 2012-02-10
Duration: 1 hour

Sachin Schina, Analyst, Thomsson Innovation
Topic: Understanding the LTE report from Thomsson Innovation.
Date: 2012-03-21
Duration: 1 hour

Elvir Causevic, Analyst, Ocean Tomo
Topic: Understanding the IPQ score methodology.
Date: 2012-03-07
Duration: 1 hour

Detailed study on Citations Interviews

Patrik Rydman, Patent Expert, Swedish Patent & Registration Office
Topic: What determines if a patent get cited or not.
Date: 2012-03-29
Duration: 1 hour

Marie Gedda, Patent Portfolio Manager, Ericsson
Topic: Understading of Ericsson's internal patent relevance classification system.
Date: 2012-03-30
Duration: 1 hour

Appendix III – Patent Relevance

The internal relevance classification system is built up on the basis that patents needs to be ranked in order to be prioritized economically. This means that a patent that is ranked high is considered to be of high importance and should therefore be invested in. However a low ranking does not mean that the patent is of no importance for the business it is rather a way to allocate the limited economical resources. To build up the relevance ranking five criterions are used:[29]

Criteria	Explanation
Standard	This criterion measures if the claimed invention is of value for an existing standard or not. If the patent is adopted or proposed to be adopted it will receive a high score.
Product and implementation	If the claimed invention is or is planned to be implemented in present or future strategic products this criteria receives a higher score.
Technology	The claimed invention belongs to a certain technology area. If the company has certain technology focus areas and the examined invention is part of such technology area the relevance ranking is likely to become higher.
Problem & Solution	The uniqueness and usefulness of the claimed invention can be examined by checking whether the invention is one of many solutions to the problem and how useful it is in the industrial setting. A more useful and unique invention is judged to be of higher value for the company.
Licensing	The claimed invention can already be part of a licensing deal as well as planned to b part of a future deal, this would indicate a high value for licensing. This criterion should also measure amount of effort needed to detect infringement, an aspect that needs to be considered when out-licensing a technology.

Table 14 - Criteria for internal relevance ranking

The value for licensing and value for standard is considered to be of highest importance since these are the main revenue drivers in the telecom industry.

The outcome of the relevance examination is a relevance class for each patent. The study divided the selected portfolio into a High and a Low relevance portfolio based on the relevance classification for each patent.

[29] Interview with Marie Gedda, Ericsson on April 2, 2012