Patent Portfolio Benchmarking
In the Logistics Industry
Are Patents Relevant for Competitiveness in the Logistics Industry?

Ioana Stefan

Supervisors: Lars Bengtsson (Gävle University)
Björn Ulmer (Deutsche Post DHL)

Examiner: Robin von Haartman

Student thesis, Master (one year), 15 HE
Industrial engineering and management
Master Program in Management of Logistics and Innovation
Abstract

The present Master thesis was written during an internship at Deutsche Post DHL Solutions\& Innovations, a subsidiary of Deutsche Post DHL. The main purpose was to make a patent portfolio benchmark for the previously identified business competitors of the DPDHL group. The research questions aimed to find out how relevant the patent portfolio analysis is for comparing competitors and whether or not the results can be matched with other types of rankings. The benchmark was made using the PatentSight software tool. PatentSight allows the patent portfolio analysis of individual companies as well as groups of companies (competitors). The software tool is based on a new approach to benchmark patent portfolios called Patent Asset Index. This approach uses several indicators to measure the patent portfolios strengths. The indicators are based on relatively widely used measures of patent analysis such as the number of citations that a patent has received. However, these measures are further adjusted by the PatentSight indicators in order to prevent false results due to the difference in patents’ ages, for instance. The results of the patent portfolio benchmark and their comparison with other rankings have confirmed previous research findings that the patent portfolio analysis is a useful tool which can remove uncertainties and provide new perspectives but cannot be used as single indicator of the competitors’ strength.

* Due to a confidentiality agreement with the Deutsche Post DHL several paragraphs and subchapters have been partially or completely removed from the present publishable version of the Master thesis.

Keywords: Deutsche Post DHL; PatentSight; Patents; Patent portfolio benchmarking; Patent analysis software tool
Acknowledgements

This Master thesis was written during an internship at Deutsche Post DHL (DPDHL) Solutions & Innovations, a subsidiary of Deutsche Post DHL (DPDHL). The internship has provided the opportunity to apply knowledge gained during the Master studies in Logistics and Innovation Management as well as during distance courses in Intellectual Property Rights.

I would like to thank both my academic supervisor, Prof. Dr. Lars Bengtsson, and my supervisor at DPDHL, Björn Ulmer, Director/ Head of Corporate Patent Management, for allowing me to work individually while always being available to provide support and advice.

I also wish to thank Marco Richter und Isumo Bergmann from PatentSight for their valuable input and their support throughout my learning to use the PatentSight software tool.

I would further like to thank the whole Corporate Patent Management team and all the colleagues at DPDHL Solutions & Innovations for making my stay in Germany during this internship such a great experience.

Last but not least, I wish to thank my family for being so helpful and understanding and for supporting and encouraging me all the way.
Contents

Abstract .................................................................................................................................3
Acknowledgements ..............................................................................................................4
1. Introduction .....................................................................................................................7
2. Purpose ...........................................................................................................................10
   2.1. Research questions ..................................................................................................10
3. Methodology ..................................................................................................................11
   3.1. Overall approach ....................................................................................................11
   3.2. Methodology details ...............................................................................................12
   3.3. Limitations and quality of study .............................................................................14
4. Theoretical framework ....................................................................................................15
   4.1. General theoretical aspects about patents ...............................................................15
       4.1.1. Patent portfolios ...............................................................................................16
       4.1.2. Patent indicators .............................................................................................16
   4.2. Patent analysis .........................................................................................................17
       4.2.1. Patent strategy ................................................................................................17
       4.2.2. Benchmarking ................................................................................................18
   4.3. Patent Asset Index – a novel approach to benchmark patent portfolios .............18
       4.3.1. Overview of companies providing patent portfolio analysis tools ...............18
       4.3.2. Patent Asset Index and PatentSight ...............................................................19
   4.4. Previous research and research gap .........................................................................20
5. Findings ..........................................................................................................................23
   5.1. Results for the MAIL division .................................................................................23
       5.1.1. MAIL competitors over time ..........................................................................23
       5.1.2. MAIL competitors in the present ....................................................................23
   5.2. Results for the EXPRESS division ..........................................................................23
       5.2.1. EXP competitors over time ............................................................................23
       5.2.2. EXP competitors in the present ....................................................................23
   5.3. Results for the DGFF division ................................................................................23
       5.3.1. DGFF competitors over time ..........................................................................23
       5.3.2. DGFF competitors in the present ....................................................................23
   5.4. Results for the SC division .....................................................................................23
       5.4.1. SC competitors over time ..............................................................................23
       5.4.2. SC competitors in the present .......................................................................23
6. Analysis ................................................................................................................................. 24
   6.1. Contrasting the results with previous research ................................................................. 24
   6.2. MAIL competitors analysis ............................................................................................ 25
   6.3. EXP competitors analysis .............................................................................................. 25
   6.4. DGFF competitors analysis ............................................................................................ 25
   6.5. SC competitors analysis ................................................................................................. 25
7. Conclusions. Future work ...................................................................................................... 26
   7.1. Scientific contributions .................................................................................................... 26
   7.2. Managerial implications ................................................................................................. 26
   7.3. Future work .................................................................................................................... 26
8. References ............................................................................................................................ 27
1. Introduction

This master thesis was written during an internship at DPDHL Solutions & Innovations, a subsidiary of Deutsche Post DHL (DPDHL). Due to a confidentiality agreement with the Deutsche Post DHL several paragraphs and subchapters have been partially or completely removed from the present publishable thesis version. The thesis aims to benchmark DPDHL and its main competitors on the basis of intellectual assets, more specifically patent portfolio analysis. Since DPDHL is one of the major players in the logistics international market, the introduction part will provide an overview of the logistics industry a short argumentation on why patent portfolios could be of interest to companies that are active in the logistics market and a preview of the previous research done in this area and the research gap that has been identified.

“Logistics” originates from the Greek word “logistikos” which translates into “skilled in calculating” (Farahani et al, 2009). According to the World Economic Forum (2012), in the recent years the developments in the logistics sector were driven by the “geographic fragmentation of production”. This is confirmed, for example, by the 7.3% market growth in 2007 (Research and Markets, 2013).

The logistics industry currently experiences “strong growth rates” as well as major challenges. Logistics is becoming more and more global and thus the companies in this industry need to be more competitive. Furthermore, the increasingly limited resources contrast with the increasing customer demands. This results in increased uncertainty in the logistics competitive environment. (Von der Gracht and Darkow, 2010)

Thus, when considering the growth as well as the turbulent environment in the logistics industry, the question that arises is why would patents be of importance to logistics companies?

“The ability of firms to effectively use mechanisms that support them in profiting from technological innovation is key to outperforming competitors.” (Fischer and Henkel, 2013)

The technological innovation that Fischer and Henkel (2013) refer to is also likely to require protection – for instance, in the form of patents.

The importance of patents and their value to companies has been experiencing an upward trend. This is why economic research is relying more and more on patent statistics. (Baron and Delcamp, 2010) “Systemic knowledge assets” are categorized as “the most visible knowledge assets”. Patents for instance, are also included in this category. (Nonaka et al, 2000)

“To manage knowledge creation and exploitation effectively, a company has to ‘map’ its stocks of knowledge assets.” (Nonaka et al, 2000)

Maguire and Moberly (2013) refer to the current economy as a “knowledge – based economy”. This translates into the fact that intangible assets have become the main source of revenue for most firms. According to Maguire and Moberly (2013) more than 65% of most firms’ value and revenue is sourced straight from intangible assets, such as patents. Patent analysis may be used for organizing a company’s patent portfolio and also for keeping track of the competitors (Borregard and Rydfjord, 2012).

According to Davis and Harrison (2001), a competitive assessment would answer following questions:
● “What are my competitors doing?
● What patenting trends are happening in my industry/market?
● What is the current pace of innovation? Of my company? Of my competitors?
● What white space might be available to the company?
● What companies might be possible licensing candidates?” (Davis and Harrison, 2001)

Efficiency comparisons can be achieved through patent portfolio benchmarking. This way, the strengths and weaknesses of companies can be easier identified. (O’Connel, 2011)

Coers et al (2001) define benchmarking as: “comparing and measuring your organization against others, anywhere in the world, to gain information of philosophies, practices, and measure that will help you take action to improve its performance.”

The transport and logistics branch is among the “newcomers” in the patent protection area. More than two decades ago, there were no patents at all in this industry; the logistics patent-related activities began in the late 90’s. Nowadays, some players in the global logistics market have hundreds of protected inventions. It is thus extremely relevant to benchmark the main competitors in the logistics branch based on a patent portfolio analysis. (Gassmann and Bader, 2006)

Large companies with high shares of foreign sales are more likely to have high numbers of patent applications. Such companies often use patents strategically in order to gain a competitor advance. The main reason to have patents is being able to “block” other competitors. (Neuhäusler, 2012)

Strategic patents ensure the ability to block competitors and keep the “freedom of action.” Moreover, in the case of large companies the presence in international markets is essential. Thus, “going global” requires protecting the intellectual assets in more than one country. There is a direct link between a firm’s patent portfolio strength and its success. However important patent portfolios and patent management are becoming, there are sectors in the industry that have been so far neglected from the intellectual property literature point of view. (Bader, 2007)

Niemann et al (2013) confirm that few scientific papers managed so far to coordinate the intellectual property management with the logistics sector. Bader (2007) suggests that the legal protection of intellectual assets in the service industry is a rather novel concept. Yet, the innovativeness of the service sector has been brought to discussion by research papers. Hipp and Grupp (2005) point out to the need of developing a new innovation typology for the service industry.

Ernst (2003) argues that patent protection is a valuable means to attain competitive advantage while also suggesting that patent information may be less relevant in industries such as service. In the past decade though, the patents in the logistics sector have experienced a lot of changes. For instance, Zhang et al (2006) point out to the applicability of RFID technologies in the postal, courier services as well as in the supply chain logistics. As the logistics sector is more and more relying on new and improved technologies, it is imperative that the major logistics players be benchmarked from a patent portfolio point of view.

Because of the recent development of patents in the logistics industry, there are few research papers that have previously analyzed business competitors from a patent portfolio perspective. Previous scientific papers related to this thesis’ topic have analyzed the efficiency of patent indicators or have compared different patent portfolio benchmarking methods. Some previous works introduce new approaches on patent portfolio analysis. These will be described in details in section 4.3.
Since this paper was written during an internship at DHL Solutions & Innovations. The patent portfolio analysis will focus on logistics companies; the decision to analyze them was prior to the internship and to the thesis and was not based upon patent-related reasons. The business competitors are grouped according to the four DPDHL divisions which will also be analyzed in this paper from a patent portfolio perspective. The logistics market can be split in two main branches: CEP – Courier, Express, Parcel (Postal) – and Contract Logistics. The Contract Logistics branch has sub-branches of Forwarding, Freight and Supply Chain. The diagram below shows the afore-mentioned logistics industry division. The four DPDHL divisions that will be analyzed (along with their business competitors) also follow this classification: the MAIL division, the EXPRESS division, the DGFF division and the SC division.

![Diagram of Logistics Industry Branches](image)

**Figure 1 - Logistics industry branches**
2. Purpose

In spite of the innovativeness observed in the service sector in the recent years, little research has been made in the field of patent portfolios of logistics companies and there is very little data available about the competitiveness of major logistics players. This brings us to the present thesis which attempts a benchmark of global competitors in the logistics sector based on their patent portfolios. The main research gap is the lack of scientific papers about applying patent portfolio benchmarking to the logistics industry.

The purpose of this thesis is to analyze the main identified business competitors of DPDHL from a patent portfolio point of view. This analysis is to be done with the help of a software tool called PatentSight which will be presented in the next chapters. Since DPDHL and some of its business competitors are international logistics companies, this analysis is expected to give an overview of the logistics sector from a patent perspective.

2.1. Research questions

The research questions that this paper should answer are:

- What is the current status of the logistics industry in terms of patent portfolios development over time, types of patent strategies and strongest competitors from a patent portfolio point of view?

- What is the relevance of the patent portfolio benchmark results? Do the results confirm rankings based on revenues, profitability?

Patent portfolio benchmarking is a useful and relevant tool, especially in the industries where the use of patents or utility patents is growing. However, the patent portfolio benchmark methods still have many limitations. These limitations may lead to incorrect assessments of competitors and the strength of their patent portfolios.

Mizuta et al (2009) point out that “the value of intangible assets has become increasingly important for estimating the value of an enterprise”. The same authors also suggest that in the asset management market, fewer alternatives are available as opposed to, for instance, financial analysis. Borregaard and Rydalfjord (2012) also emphasize the “lack of consensus regarding which aspect to consider when evaluating the patent portfolio strength”.

Chesbrough (2007) points out to the “waste” of “potentially valuable innovation” and suggests a method of measuring this waste based on companies’ patent utilization rate. Borregaard and Rydalfjord (2012) argue that the shift in paradigm from closed to open innovation has made the intellectual property rights gain importance.

“Economists traditionally rely upon patent data to measure innovation and technology transfers. This use is challenged by the unequal patent quality and the high number of unused patents. In order to compare the technological quality and commercial value between patents and to single out those patents that are actually used, economic research has come to use various indicators of patent quality.” (Baron and Delcamp, 2010)

The indicators of patent quality mentioned by Baron and Delcamp (2010) also have limitations and shortcomings. However, there are several patent quality indicators that are agreed to be more relevant than others. More details about the patent quality indicators will be presented in the Theory framework chapter.
3. Methodology

The Methodology chapter describes how the results were obtained, more specifically, which method was applied and how the data was collected. The chapter is divided into three sections: the first section presents the overall approach; the second section shows the details of the applied method and the third section describes the limitations of the method and how these affected the overall quality of this thesis.

3.1. Overall approach

Scientific research differentiates two main types of research: qualitative and quantitative. Mahoney and Goertz (2006) regard quantitative and qualitative research as two different cultures; they describe qualitative research as focused on particular cases, while the quantitative research attempts explaining average outcomes. Mahoney and Goertz (2006) further explain the difference between the quantitative and qualitative research by emphasizing the fact that both approaches begin with general questions; however, the qualitative research will reformulate the question by referring it to an individual case, while the quantitative research will keep the question general and refer to an average outcome. Newman and Hitchcock (2011) suggest that qualitative research focuses on details and “rich description of data”. In spite of the differences between the two research methods, Bryman (2006) points out to the fact that qualitative and quantitative research are increasingly applied in combination, rather than separately. Figure 2 shows the main differences between the two types of research. As stated before, the qualitative research is rather oriented towards particular cases, while the quantitative research focuses on broader aims and patterns.

<table>
<thead>
<tr>
<th>Section</th>
<th>Criterion</th>
<th>Qualitative</th>
<th>Quantitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Approaches to explanation</td>
<td>Explain individual cases; “causes-of-effects” approach</td>
<td>Estimate average effect of independent variables;</td>
<td>“effects-of-causes” approach</td>
</tr>
<tr>
<td>2 Conceptions of causation</td>
<td>Necessary and sufficient causes; mathematical logic</td>
<td>Correlational causes; probability/statistical theory</td>
<td></td>
</tr>
<tr>
<td>3 Multivariate explanations</td>
<td>INUS causation; occasional individual effects</td>
<td>Additive causation; occasional interaction terms</td>
<td></td>
</tr>
<tr>
<td>4 Equifinality</td>
<td>Core concept; few causal paths</td>
<td>Absent concept; implicitly large number of causal paths</td>
<td></td>
</tr>
<tr>
<td>5 Scope and generalization</td>
<td>Adopt a narrow scope to avoid causal heterogeneity</td>
<td>Adopt a broad scope to maximize statistical leverage and generalization</td>
<td></td>
</tr>
<tr>
<td>6 Case selection practices</td>
<td>Oriented toward positive cases on dependent variable;</td>
<td>Random selection (ideally) on independent variables;</td>
<td></td>
</tr>
<tr>
<td>7 Weighting observations</td>
<td>Theory evaluation sensitive to individual observations;</td>
<td>All observations are a priori equally important; overall pattern of fit is</td>
<td></td>
</tr>
<tr>
<td>8 Substantively important cases</td>
<td>Substantively important cases must be explained</td>
<td>Substantively important cases not given special attention</td>
<td></td>
</tr>
<tr>
<td>9 Lack of fit</td>
<td>Nonconforming cases are examined closely and explained</td>
<td>Non-systematic causal factors are treated as error</td>
<td></td>
</tr>
<tr>
<td>10 Concepts and measurement</td>
<td>Concepts center of attention; error leads to concept revision</td>
<td>Measurement and indicators center of attention; error is modeled and/or new indicators identified</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2 - Contrast between qualitative and quantitative research
(Source: Mahoney and Goertz, 2006)

The topic of this thesis began from a general question; it was then narrowed down to the analyzed companies that were eventually considered in the patent portfolio benchmark. Therefore, the main approach used is qualitative, as the analysis does not encompass the multitude of companies active in the logistics industry that also own patents, but rather focuses on several selected companies.

Hox and Boeije (2005) show the differences between the primary and secondary types of data collection: the primary data is gathered for a particular research topic but has the disadvantage
of being a time- and resource-consuming process; secondary data is collected by someone other than the researcher using it and it is data that was initially gathered for a different original purpose. According to Hox and Boeije (2005) the disadvantages of using secondary data are that the identification of the data sources as well as the relevance of the data itself for the own chosen topic.

This paper has used secondary data made available by the PatentSight software database for the patent portfolio analysis. Further secondary data about the analyzed competitors was collected from different sources such as companies’ annual reports.

Wu et al (2010) indicate that literature review is an “essential step” when researching any topic. For this paper electronic databases were mainly used to find scientific articles related to the chosen topic. Even though there is little prior data about patent portfolio analysis in the logistics industry, scientific papers and books about patent portfolio benchmarking and patent quality indicators were identified. The next section will present the new approach used for the present patent portfolio benchmark and the software tool used for the patent portfolio analysis of the considered companies.

3.2. Methodology details

The current patent portfolio benchmark methods have several limitations. One limitation is that many rely only on US patent data. This makes international comparisons difficult and inaccurate. Furthermore, only about a fourth of all inventions globally are contained in the US patent data. Another limitation is that analyses often include only US patent granted in the past year. This in turn limits the ability to base the analysis on patent citations due to the fact that newer patents generally have fewer citations than older patents do. Not taking into account the patent applications is a third limitation of current patent portfolio benchmarking methods; however, it may take years for a patent to be granted. Last but not least, the indicators used for determining the patent value are often incomplete, not taking into account all factors that may determine the real strength of the patent. (Ernst and Omland, 2011)

Lee et al (2012) also mention the limitations of previous and current patent analysis methods, which initially relied only on patent counts and then evolved towards patent citations analysis; the current patent citations analysis are presented to have yet many deficiencies. Collan et al (2013) confirm the shortcomings of patent analysis and valuation. Hsieh (2013) signals the increasing importance that patent analysis has gained from both academic and business perspectives.

As mentioned in previous chapters, this thesis will make a patent portfolio benchmark of a group of logistics companies. The patent portfolio benchmark is made with the help of a software tool called PatentSight. The software tool is based on a new approach of patent portfolio benchmarking called Patent Asset Index (PAI) and described by Ernst and Omland (2011). The PatentSight software tool provides insights to worldwide companies’ patent portfolios and the possibility to make comparisons between firms based on their patent portfolios size and strength. The PatentSight database contains patent information from worldwide patent databases such as Espacenet (provided by the European Patent Office) or Uspto (provided by the United States Patent and Trademark Office) but also from national patent offices around the world.

The next section will present details about the PatentSight features and limitations as well. It will also be shown which features of the software tool were used for the patent portfolio benchmark and how that was achieved. In the literature research conducted for this Master thesis no studies were found in which the PatentSight patent analysis software tool had been
used or that compared the software tool or the Patent Asset Index approach with other similar methods. The reason for the lack of data may be related to the fact that both the Patent Asset Index approaches for benchmarking patent portfolios as well as the PatentSight software tool, which relies on the Patent Asset Index approach, are part of a new approach – Ernst and Omland introduced the Patent Asset Index approach in 2011.

The user can search and filter data in the PatentSight software tool with the help of following filters: Owner, Patent Set (Tag), Publication Date Range, Active in Country, Keyword Combination. Additional user designed filters can be created and applied. The preset filters each have sub-filters to allow more accurate sorting of patent information.

The Owner filter allows the user to search for patent information of a certain company. The user may apply additional sub-filters such as Owner of citing or cited patents. These sub-filters are helpful when, for instance, the user wishes to identify the patents cited by a certain company or the patents citing patents owned by a firm as “prior art”.

The Patent Set (Tag) filter enables filtering patents according to own created sets of patent families. The patent sets can be created either by searching for certain patent families and adding them to a patent set or by uploading a pre-defined list of patents. The Patent Set (Tag) filter has no sub-filters.

The Publication Date Range filter allows the user to sort patents according to the date at which they were published. Further sub-filters allow selecting patents according to the date at which they were filed or the date when the first patent was published that the patent family claims legal priority.

The Active in Country filter enables searching for the patents that are protected in certain countries. Further sub-filters also allow search according to a patent’s country of origin, the country or countries patent applications were filed or granted.

The Keyword Combination filter allows the user to search for patents that contain certain words or in their title or abstract.

Additional filters that the user may apply are also:

- Original Applicant – which allows searching for a patent by its original owner; this can be useful in the case a patent was sold and thus the legal rights to it transferred to another company than the one that was the initial applicant
- IPC – this filter enables the search for patents according to the IPC group they belong to. (IPC stands for International Patent Classification; the IPC groups filter patents according to different technology fields)
- Age – allows the user to search for patents that are a certain “age”; this refers to the time passed in which the invention has been protected.
- (Citing/cited) Patent Number – the user may search for a certain patent number and can further extend the search to find patents cited by the patent family or patents citing the patent family.

The PatentSight software tool also allows the user to upload lists of patents, to process them in order to find their matches in the database and to add them to a Patent Set. Patent family details can also be exported to Excel documents or can be saved directly on the server and accessed from the PatentSight software tool.

PatentSight provides templates that are useful for the patent analysis – for instance, chart templates showing a company’s or several companies’ patent portfolio size trend over time – however, the user also has the option to create their own custom charts and/or tables by selecting the indicators they wish to analyze.
In order to do the patent portfolio benchmark for the selected companies, the Owner, Owner of citing/cited patents, Active in Country and Patent Set filters were mainly used. The Owner filter was applied in order to select and compare the patent portfolios of those companies that were considered in the benchmark. The Owner of cited/citing patents was used for identifying the companies that had cited patents of competitors and whose patents had been cited by other competitors. The Active in Country filter was used to determine the countries where the selected companies were most active in. The Patent Set filter was applied to group patents of a specific company that belonged to certain divisions or certain activity fields. For example, the patents of different divisions of the DPDHL were grouped accordingly using the Patent Set filter. The above-mentioned templates were used to compare the development of the considered companies’ patent portfolios over time. Mainly due to time constraints but also due to decreased relevance, other PatentSight filters and templates were not applied in this patent portfolio benchmark.

The obtained results from applying the filters and using templates in PatentSight were compared for each DPDHL division. Furthermore, the companies rankings based on the patent portfolio benchmarking was compared to other rankings based on revenues and profitability in order to determine the relevance of the results and of the applied method.

3.3. Limitations and quality of study
4. Theoretical framework

This chapter presents theoretical aspects relevant to the thesis topic as well as previous research papers that are found significant for this paper. The theory presented is related to patents, patent indicators and patent strategies. Furthermore, the theoretical framework behind the Patent Asset Index (PAI) approach is detailed. The previous work refers mainly to previous patent portfolio benchmarks made in other industries.

4.1. General theoretical aspects about patents

“A patent is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem.“ (WIPO, 2013)

Patents are usually valid for a period of 20 years. A patent’s life-cycle is composed of five stages: exploration (patent-scanning), setup (patent-monitoring), protection, optimization and, finally, removal.

Table 1 - Norm-strategies for strategic portfolio management (Gassmann and Bader, 2006)

<table>
<thead>
<tr>
<th>Strategic Significance</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploring</td>
<td>- Evaluating potentials through industry-comprehensive patent researches (patent scanning)</td>
</tr>
<tr>
<td></td>
<td>- Registering broad, conceptual patents where potentials have been identified</td>
</tr>
<tr>
<td>Structuring</td>
<td>- Conducting systematic patent research</td>
</tr>
<tr>
<td></td>
<td>- Analyzing competitive activities</td>
</tr>
<tr>
<td></td>
<td>- Registering strategic patents</td>
</tr>
<tr>
<td></td>
<td>- Registering cross-industry patents</td>
</tr>
<tr>
<td></td>
<td>- Verifying the potential of patent licenses exchange</td>
</tr>
<tr>
<td>Securing</td>
<td>- Structuring patent-cluster to ensure systematic security for competitive advantages: broad base-patents and patents with specific implementation alternatives</td>
</tr>
<tr>
<td></td>
<td>- Verifying licensing possibilities in other domains (on a long-term basis)</td>
</tr>
<tr>
<td>Optimizing</td>
<td>- Verifying patent-cluster according to cost-benefit considerations</td>
</tr>
<tr>
<td></td>
<td>- Protecting from substitution-technologies through defensive patents</td>
</tr>
<tr>
<td></td>
<td>- Verifying licensing possibilities</td>
</tr>
<tr>
<td></td>
<td>- (on a short-term basis)</td>
</tr>
<tr>
<td>Reducing/removing</td>
<td>- Verifying exclusive licensing possibilities</td>
</tr>
<tr>
<td></td>
<td>- Renouncing or selling patents</td>
</tr>
</tbody>
</table>

Low Resource-strength High
4.1.1. Patent portfolios

In the patent portfolio, patents are classified by their relevance. Here, the protection areas as well as the traceability of infringement for a certain patent are most valuable factors. Further categorization can be made according to products and countries. The countries must be strategically evaluated in order to determine their relevance for the market and production. (Gassmann and Bader, 2006)

Gassmann and Bader (2006) present three ways of evaluating patent portfolios. The first method is the monovariant method, which relies on one qualitative indicator for the portfolios comparison. The second way to evaluate portfolios is bivariate, relying both on turnover and on number of patents. The third method is based on three variables: relative patent position, technology-attractiveness and technology importance (significance). This can in turn be depicted as three-dimensional representation of patent portfolio. There are significantly more evaluation methods for patent portfolios from a quantitative point of view (Gassmann and Bader, 2006)

4.1.2. Patent indicators

Indicators are used in measuring patent portfolios from different perspectives. The indicators may point out to the claims number or to the number of times a patent has been cited. Furthermore, patent counts are sometimes considered relevant to assessing a company’s patent portfolio. However, not all patents have the same market value and therefore the number of patents may turn out to be an inaccurate measurement. (Baron and Delcamp, 2010)

Table 2 - patent quality indicators (Baron and Delcamp, 2010)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward cites</td>
<td>Number of citations received by posterior patents</td>
<td>Indicates the relevance of the patent for further research</td>
</tr>
<tr>
<td>Backward cites</td>
<td>Number of citations made to previous patents</td>
<td>Indicates the extent to which the patent makes use of the existing prior art</td>
</tr>
<tr>
<td>Number of claims</td>
<td>The number of priority claims made in the patent</td>
<td>Indicates the breadth of the technology claimed by the patent holder</td>
</tr>
<tr>
<td>Family size</td>
<td>The number of international patents filed for the same priority patent</td>
<td>Indicates that a patent is important on an international scale, and that its holder is willing to incur high application costs</td>
</tr>
<tr>
<td>Generality</td>
<td>Dispersion of cited patents over technology classes</td>
<td>Indicates that the patent draws from various sources, increases the likelihood that the patent is a fundamental rather than incremental innovation</td>
</tr>
<tr>
<td>Originality</td>
<td>Dispersion of citing patents over technology classes</td>
<td>Indicates that the patent has been important for a broad field of further research</td>
</tr>
</tbody>
</table>
When referring to table 2 in relation to the methodology of this paper, as previously described in the Methodology chapter, the PatentSight software tool and its indicators are mainly based on forward and backward cites and family size. Why are citations important and used as an indicator for a patent’s quality?

If a patent covers certain technological concepts that are actively researched, then the future patents resulted from the research and development investments in this technology area will most likely cite the afore-mentioned patent. Hence, if patents are cited more often, they become more technologically relevant and thus more valuable. (Ernst & Omland, 2011)

The basic strategy for protection against patent infringements relies on four pillars: counter attack of the validity of the complaints, counter statement, counter attack of product-, technology- and services-lineup, and other legal, political, etc. steps to influence the infringement process. (Gassmann and Bader, 2006)

4.2. Patent analysis

Patent analysis represents the specific evaluation of competitors’ patent information. The aims of patent analyses are:

- Evaluating the company’s own competitive advantages
- Avoidance of time and effort invested in already patented technologies
- Appraisal of the technological strategy of competitors
- Identifying present and future core competencies of competitors
- Identifying potentially new providers
- Identifying existing and potential alliances of the competitors’ as well as their subcontractors partners
- Analysis of patents content in reference to technologies and substitution potential; especially analysis of emerging technologies
- Identifying potential licensing partners
- Optimization of own patent application strategy (defense against attacks, etc.)

It is to be noted that it may take 3-4 years from the time of patent application to the moment when the patent becomes market-relevant. (Michaeli, 2006)

4.2.1. Patent strategy

The positioning of a company from the patent management point of view can occur referring to: products and technologies, markets, financial framework. The patent strategy must view the company as a whole, while also looking into individual business segments. The main question is: “How should the firm position itself when using patent strategy?” (Gassmann and Bader, 2006)

There are several important factors for a successful patent strategy. First, it has to be in accordance with the company’s overall strategy. The Patent strategy should also fit the amount of resources that the company possesses as well as the psychological strain. Other important factors should include relying on previous experiences and being aware of the aimed for transparency degree. Patent strategies can also be categorized into offensive and defensive ones. The offensive strategies are based upon the company’s strategy. Defensive patent strategies aim to minimize the patent strategies of third party firms’ impact on themselves. Large companies are particularly prone to using hybrid patent strategies, which include both offensive and defensive strategy elements. (Gassmann and Bader, 2006)
Increased size of the patent portfolio indicates an offensive patent strategy. The patent portfolio size is furthermore important in the case of litigations. More specifically, the company with the larger patent portfolio has more “bargaining power”. (Fischer & Henkel, 2013)

However, patents’ sole purpose is not blocking competitors. It is possible that patents bring value to the owning company by open innovation practices – for instance, by being outlicensed to other companies. This may bring additional benefits to the owning company, such as positive brand exposure. (Fischer & Henkel, 2013)

4.2.2. Benchmarking

Benchmarking is defined as the comparative analysis of own processes and products with those of competitors. Aside from the direct competitors of the own industry, the benchmarking may also be done with providers outside the industry. Benchmarking aims to identify superior products or processes of the competitors and to analyze these in order to improve own products and processes. Another goal of benchmarking is to find the relative positioning in the competitive environment. (Michaeli, 2006)

The following steps may be part of the benchmarking process:

- Selecting the products and processes that have to be analyzed
- Defining the characteristic factors to be used for the comparison
- Selecting the competitors
- Primary and secondary data collection
- Data analysis and defining improvement potentials
- Alignment and implementation of acquired knowledge

(Michaeli, 2006)

4.3. Patent Asset Index – a novel approach to benchmark patent portfolios

4.3.1. Overview of companies providing patent portfolio analysis tools

There are many companies that provide tools for patent portfolio analyses. Three of the ones that were considered by DPDHL for providing a patent analysis software tool are briefly presented as follows:

- Innography
- Oceantomo
- PatentSight

Innography is an U.S. company providing services such as competitive intelligence based on IP data. Their service can further be detailed to: portfolio inventory and comparison, custom analysis to subsets of patents, patent and product mapping, targeting valuable licensing candidates, and many more. Among Innography customers are: UPS, Deutsche Telekom, Siemens, Amazon, Autodesk, IBM, Kellogg’s, Rambus, Synopsys, AT&T, (Innography, 2013)

Oceantomo is also an U.S. firm which offers services such as patent portfolio reports. The reports are to contain data about quality and age of entire portfolio and of selected groups of patents, competitors’ analysis and patent distribution. (Oceantomo, 2013)

Patentsight is a German company specializing in evaluating patent portfolio and innovation strength. They introduce a novel benchmarking method called Patent Asset Index. The Patent
Asset Index is dependent on indicators such as Competitive Impact, Technology Relevance and Market Coverage.

- Technology Relevance – indicates how important an invention is for the further technological development
- Market Coverage – measures how big the markets in which active patent or patent applications not yet granted are
- Competitive Impact – measures the business value of a patent; it also represents the product between the Technology Relevance and the Market Coverage (PatentSight, 2013)

Among the PatentSight customers are companies such as: BASF, Deutsche Telekom, BMW, Tetra Pak, ARM.

After careful comparison and software testing, PatentSight was found to be the most suitable patent portfolio analysis tool from the DPDHL perspective. The software testing and the decision making in relation to the patent portfolio analysis software tool were made prior to the internship during which the present thesis was written. Therefore, further details about the software tools valuation cannot be provided here.

4.3.2. Patent Asset Index and PatentSight

In order to precede the afore-mentioned limitations of the current patent portfolio benchmarking methods (3.1), a novel patent portfolio benchmark approach is suggested. The new approach takes into account the following indicators to evaluate the strength of a company’s patent portfolio:

- portfolio size
- market coverage (MC)
- technology relevance (TR)
- competitive impact (CI)
- patent asset index (PAI)

The portfolio size includes both active granted patents and patent applications. In order to have a complete overview of a firm’s patent portfolio, all the data from the past 20 years should be taken into consideration. It is essential to identify the patents filed for the same invention in different countries. The group of patents that protect the same invention in various countries represents the “patent family”. Moreover, the legal status of each identified patent family must be determined. (Ernst and Omland, 2011)

The market coverage indicator (MC) is defined as the “sum of the GDP of all countries” where a certain invention is protected. A discount factor is used for patent applications that have not yet been granted. The probability of 70% is considered in order to discount for the additional contribution of patent applications that have not yet been granted. The MC represents the size of the market(s) in which granted patents and patent applications are protected. (Ernst and Omland, 2011)

The technology relevance indicator (TR) is based on the number of citations received by a patent, as the patent’s worth is in strong relation to its influence or relevance for the progress of future inventions. It is further suggested that the number of citations received is more relevant than the number of patents, when measuring the patent portfolio market value. This fact is confirmed by previous research. Moreover, it takes years before patent citations occur and sum up. A recently granted patent is very likely to have received fewer citations than a patent that has already been granted for several years. A method is thus used to adjust the
differences between older patents and recently granted patents. The method consists of dividing a patent’s number of citations by the average number of citations received by all patents that have been published in that particular year. This method is included in the assessment provided by the PatentSight software tool. (Ernst and Omland, 2011)

From the product between technology relevance (TR) and market coverage (MC), the competitive impact (CI) “measurement” is calculated. The CI is a measure that characterizes each patent individually, providing insights to the patent’s overall quality and determining the potential competitive advantage of a patent. It is similarly insufficient when a patent has low TR and high MC as it is if a patent has high TR but low MC. Thus, in order for a patent’s value (quality) to be high, i.e. in order for the CI of a patent to have a high value, both TR and MC indicators are important. (Ernst and Omland, 2011)

Finally, the Patent Asset Index (PAI) shows the degree of intellectual property assets that contribute to a company’s competitiveness and turnover. In other words, the PAI is the sum of CI indicators of all patent families a company owns. Another way to calculate the PAI would be to multiply the average CI of the individual patent families in a patent portfolio by the total number of patent families in that portfolio. (Ernst and Omland, 2011)

In order to validate the above-mentioned indicators, Ernst and Omland (2011) lead study for empirical validation. The study comprised of choosing and comparing two groups of patents. Group A had high CI while the patents in group B presented no CI at all. For the first step of the study, 37,366 patent families were identified for group A and 70,000 for group B. The initial owners of the patent families in group B renounced them in the first six years after having been granted. This indicates that the patent families belonging to group B had low technological and market value to begin with. From Group A, the patent families were identified that had been attacked and had “survived the opposition”. The study's results confirmed previous research showing that the opposition-surviving patent families have on average a value that is 11.2 times higher than that of other patents (here, patents in group B). (Ernst and Omland, 2011)

4.4. Previous research and research gap

Software tools are required for nowadays patent information analyses, as patent data is found in numerous databases and patents often use a language that is hard to understand. (Masiakowski and Wang, 2013) It is particularly difficult to manage the intellectual property in the case of companies that own large patent portfolios, for instance. Firms with high patent activity use one of the three IT tools for intellectual property management for at least one of three different purposes: searching, administrating and evaluating. Companies evaluating (own and competitor’s) patent portfolios can use patent analysis software tools to improve the reliability of the evaluation. Moreover, patent data is found to be valuable for the marketing and development departments within a company. (Gassmann et al, 2012)

Various patent indicators can estimate a patent’s value. Patents that are protected in many countries or that have received a high number of citations are likely to have a high value. More accuracy in determining patent value could be attained by synchronizing companies’ patent information with patent databases. (Cozijn, 2009) This confirms both the efficiency of the patent indicators (Technology Relevance, TR and Market Coverage, MC) and the patent database used by PatentSight.
Bigger companies are more prone to use patents in order to protect their assets. Furthermore, manufacturing industries have a clear tendency to patents as compared to service industries. (Chabchoub and Niosi, 2005)

Jansen (2009) also suggests that the number of citations a patent receives is the “most established” value indicator of a patent. Jansen (2009) also mentions litigations and the number of times the renewal rates have been paid to for a patent. While litigations too are a part of the PatentSight patent valuation approach, it is not possible to find out details about the renewal rates when using the PatentSight software tool.

In Denmark, for instance, companies are recommended to analyze their patent portfolios in an attempt to encourage innovation and business development on a national level. The Danish Patent Office developed a software tool that evaluates the internal value of patents called IPscore. The tool does not however give any details about the market value of the analyzed patents. IPscore also provides data about financial forecasts and risk reports for patents. (Nielsen, 2004)

Littmann-Hilmer & Kuckartz (2009) introduce another patent portfolio analysis tool called IPC Portfolio that is best fitted for small and medium enterprises (SMEs). The tool measures the value of patents and helps distinguish between “blocking patents” that have high or low values. The “blocking patents” are meant to block other competitors from using that same product or technology. The IPC Portfolio evaluates a patent portfolio according to its market value and company value. The market value is given by such indicators as patent family size, forward and backward citations, IPC group, and claims. The company value is given by turnover and R&D investments. (Littmann-Hilmer & Kuckartz, 2009)

Baron & Delcamp (2010) evaluate patent quality indicators. The results of the evaluation show that neither a patent’s quality nor the number of citations it has received could have significant effects on the probability that it be litigated (attacked).

Borregaard & Rydfjord (2012) compare patent portfolio benchmarking methods. They find that the number of citations received by a patent is a good tool to compare patent portfolios in general; however, this does not accurately indicate individual patents’ value. Borregaard & Rydfjord (2012) also suggest that while patent portfolio benchmarking tools are unable to provide the whole “picture” of the companies and patents analyzed, it is useful to partly remove the uncertainties.

Damm (2012) presents a strategic management tool of mapping competitors’ patent portfolios in a matrix according to their matching points. The axes of the matrix indicate the business strategy and the products reflected in the patent portfolio. The matrix can be helpful in assessing new innovation areas in certain fields and identifying companies that could collaborate in the future.

Hall (1999) shows that manufacturing companies’ market value is connected with their intangible (knowledge) assets. Hall (1999) particularly views patents as more relevant indicators for the value of a company. Tucker (2002) writes about driving a company’s growth through innovation and refers to ways of measuring innovation, for instance, through “percentage of revenues derived from new products or services”.

“Managers in a broad range of industries are well aware of the importance of innovation as key driver of growth, profitability and competitive advantage”. (Tucker, 2002)

Lanjouw and Schankerman (2004) also relate patent quality with companies’ market value; they also indicate that using more than one patent quality indicator decreases the “variance in
patent quality”. Linder (2006) links a company’s profitable growth with its innovation capability. Moreover, Linder (2006) suggest that:

“Instead of measuring innovation, we should measure what we really want in the end – profitable growth. This lens has the power to incorporate all the innovations that matter”

Van Leeuwen and Klomp (2007) further confirm that innovation has an impact on the way companies perform, emphasizing the revenue-per-employee growth as more sensitive when linked to innovation.

The previous work presented in this section analyzed and compared patent quality indicators as well as patent portfolio benchmarking methods and software tools. None of the works however have made analyses in the logistics sector, thus confirming the fact that patent portfolio benchmarking in logistics is a relatively rare topic (Niemann et al, 2013; Gassmann and Bader, 2006). Therefore, the gap in research is the lack of previous benchmarks in the logistics industry and lack of knowledge on how to apply patent portfolio analysis to the logistics companies.
5. Findings

5.1. Results for the MAIL division
   5.1.1. MAIL competitors over time
   5.1.2. MAIL competitors in the present

5.2. Results for the EXPRESS division
   5.2.1. EXP competitors over time
   5.2.2. EXP competitors in the present

5.3. Results for the DGFF division
   5.3.1. DGFF competitors over time
   5.3.2. DGFF competitors in the present

5.4. Results for the SC division
   5.4.1. SC competitors over time
   5.4.2. SC competitors in the present
6. Analysis

6.1. Contrasting the results with previous research

The “Analysis” section of this paper will discuss and analyze the results while also focusing on the research questions presented in the “Purpose and research questions” chapter. In order to show how relevant patent portfolio analysis has proven to be based on this paper’s results, an approach will be used which consists of dividing the PAI by the annual revenues and by the annual profits respectively for every analyzed company. This way, the PAI value per € million of revenues and profits will be obtained, thus allowing a more in depth analysis of the patent portfolio benchmark results. This approach will help rank the competitors according to their patent portfolios strength. An even more accurate ranking could have been made by replacing the revenues with the research and development (R&D) investments and calculating the PAI value for each € millions of R&D investments made. However, R&D investment information is not generally made public by companies, thus the comparison could not be made from this particular point of view.

Before analyzing the results for each DPDHL division and its competitors, some general observations on the overall results will be made. As seen in the Theoretical framework chapter Gassmann and Bader (2006) distinguish between qualitative and quantitative patent portfolio comparisons. It has been shown when presenting the Patent Asset Index (PAI) approach and the PatentSight software tool, that they provide means for both qualitative and quantitative patent analysis.

Gassmann and Bader (2006) point out to the fact that large companies usually have hybrid patent strategies, being both offensive and defensive and Fischer and Henkel (2013) suggest that companies with large patent portfolios are usually offensive in their patent strategy. The offensive strategies can be observed in the beginning of the Results chapter; however, the defensive trends in strategy cannot be clearly observed from the results, as the PatentSight software tool does not provide data about licensed patents.

As Michaeli (2006) suggests, benchmarking aims to find the companies’ positioning in the competitive environment. This goal is achieved by the results, both in the “over time” charts showing how the patent portfolios sizes and strengths developed, as well as in the “present” section. The positioning is quite clear especially for the companies with larger portfolios and strong PAI values. In the case of the companies with smaller patent portfolio sizes, it is difficult to make final statement because for some of them there was no patent data available. However, if new patent data were made available, their position in the competitive environment could change, even become stronger. The other goal of benchmarking suggested by Michaeli (2006) is the identification of competitor’s superior products or services, having as ultimate goal the improvement of own products and services. This goal was neither aimed nor achieved by the current patent portfolio benchmark. The current benchmark is meant to provide a general overview of the considered logistics competitors. The identification of strong products (patents) would require a more in depth analysis of the each competitor’s patent portfolio.

As suggested by Hall (1999); Tucker (2002); Linder (2006) and Van Leeuwen and Klomp (2007) the current analysis will further attempt to link the analyzed companies profitable growth or market value with their patent development. As mentioned in the beginning of this chapter, the competitors will be analyzed by comparing the Patent Asset Index (PAI) to the annual revenues. The strongest competitors identified in the results of the patent benchmark will also be analyzed by comparing the PAI to their net profits.
After having analyzed the results for the four divisions and their competitors, the research questions will be restated and answered in the Conclusions chapter. In the same chapter, the managerial and theoretical implications sourced from this paper will be discussed and further recommendations and observations about potential future work will be made.

6.2. MAIL competitors analysis
6.3. EXP competitors analysis
6.4. DGFF competitors analysis
6.5. SC competitors analysis
7. Conclusions. Future work

7.1. Scientific contributions

7.2. Managerial implications

7.3. Future work

As mentioned in the answer for the previous question, the results mainly confirm the rankings of the business competitors but also show the competitors from a different point of view. One aspect worth considering is that the competitors analyzed in this paper are business competitors. Are there other potential competitors who are not (yet) business competitors but are already competitors from a patent portfolio perspective? This is one idea that future research papers may take into consideration.

The only approach used in this paper for the benchmark was the Patent Asset Index introduced by Ernst and Omland (2011), which is also the framework behind the PatentSight software tool. In order to validate results and also to evaluate the software tool, an idea for future work would be to compare the PatentSight tool and the Patent Asset Index benchmark methodology with other similar software tools and approaches.
8. References


Bryman, J., (2006), Integrating quantitative and qualitative research: how is it done? Qualitative Research, vol. 6, pp. 97-113

Chabchoub, N., Niosi, J., (2005), Explaining the propensity to patent computer software, Technovation, Vol.25, pp 971-978


Investopedia, (2013), Conglomerate, Investopedia US, Available at: http://www.investopedia.com/terms/c/conglomerate.asp,


Jansen, W., (2009), Examining the relation between patent value and patent claims, Master Thesis Report, Eindhoven University of Technology


O’Connel, (2011), Harvesting external innovation – Managing external relationships and intellectual property, MPG Books Group, UK


