A Comprehensive Classification of Business Activities in the Market of Intellectual Property Rights-related Services

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Technology and intellectual property markets have witnessed great developments in the last few decades. Due to intellectual property rights gaining more importance and technology companies opening up their innovation processes, a wide range of intellectual property rights related services have emerged in the last two decades. The goal of this research is to develop a comprehensive classification system of intellectual property rights related services (IPSC). The classification is created by applying an ontology engineering process. The IPSC consists of 72 various IPR services divided into six main categories (100 Legal Service; 200 IP Consulting; 300 Matchmaking and Trading; 400 IP Portfolio Processing; 500 IPR-related Financial Service; 600 IPR-related Communication Service). The implications of the thesis are directed to policy makers, technology transfer managers, C-level executives and innovation researchers. The IPSC enables practitioners and researchers to organize industry data that can be thereafter analyzed for better strategy and policy making. In addition, this contributes towards organizing a more transparent and single intellectual property market.

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Abstract

Technology companies have become more specialized and have started to outsource some of the commercialization related processes in the last decades (Palmisano, 2006). Intellectual property rights play an important role for technology companies´ business and technology commercialization strategies (Tietze, 2010). Patents are not seen as static goods any longer, but rather as an asset class (Monk, 2009). As a result, technology markets have witnessed great developments during the last two decades. Due to intellectual property rights gaining more importance and technology companies opening up their innovation processes, a wide range of intellectual property rights related services have emerged in the last two decades (Prilop et al., 2012). The intellectual property related service providers play an important role in accelerating technology transfer and bringing new innovations to market. Nevertheless, research on intellectual property rights related service markets is minimal.

This thesis is an attempt to model the intellectual property related service market. The goal of this research is to develop a comprehensive classification system of intellectual property rights related services (IPSC). The IPSC is a set of all activities provided by intellectual property rights service providers for technology firms and individuals. First, definitions and terminology for the various services are collected. Second, a classification system based on the analysis of the intellectual property rights service providers' activities is created.

In order to assemble, define, classify and index the set of intellectual property related services up to date design science is used. For creating a taxonomy, ontology engineering method "methontology" presented by Fernandez et al., (1997) is chosen. As a result of the methodology, the set of intellectual property related services terminology is divided into six main categories. The full IPR service categorization consisting of seventy-two various services with their corresponding definitions is conceptualized, formalized, evaluated and realized.

The classification created within this work through the nine steps required for ontology engineering process is validated by collecting IPR service market data, conducting industry interviews and studying existing literature. In total, the Intellectual Property Services Classification (IPSC) has been validated by analyzing more than 4,100 IPR service providers' activities. Forty-two expert interviews were conducted for evaluation

purposes and the finalization of the IPR services taxonomy was carried out in one full day workshop with an expert group.

The implications of the thesis are directed to policy makers, technology transfer managers, C-level executives and innovation researchers. The IPSC will help to increase the awareness - and culture of intellectual property. It will assist with strategy building for intellectual property service providers themselves. The IPSC enables practitioners and researchers to organize industry data that can be thereafter analyzed for better strategy and policy making. In addition, this contributes towards organizing a more transparent and single intellectual property market.

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1. Introduction

1.1. Introduction to Technology Markets

Technology markets have had several simultaneous shifts in the last decades. First, there have been tremendous organizational changes that have affected the division on labor and technology production processes (Palmisano, 2006). As firms develop innovative services that affect the traditional division of labor among firms that are active in various forms of technology transactions the IPR market keeps developing further. Therefore, parallel to organizational changes another shift has happened. Namely industrial property rights (IPRs) have been evolving from purely exclusionary instruments into intangible assets that play an important role in business strategy (Monk, 2009). IPRs have developed into a recognized asset class within the last decade (Hagiu and Yoffie, 2011). IPRs are no longer static property rights. Patents can be traded or sold and therefore are seen as important goods for technology companies` strategic developments (Monk, 2009). These intangible assets have a limited lifetime and without monetization efforts, a patent can be seen just as a cost for an inventor or a company. Therefore, it is important to put the IPR to use for innovation processes. Many technology companies have realized this and are actively pursuing their IP rights (Tonisson and Maicher, 2012). The proof of this is increasing patenting rates, litigation cases regarding IPR infringements and activities undertaken with patents (Blind et al., 2006).

One of the drivers for such changes can be the organizational changes in technology companies. The way technology companies function has changed since the eighties. Three decades ago, they functioned as a collection of divisions based in various regions, business units, or product lines. Nowadays technology companies are organized often as an array of specialized business-units (e.g. procurement, manufacturing, research and development, marketing, sales, IP management, and distribution, etc.). In this setting, they gradually have opened up their innovation processes and are outsourcing some of the fragments of the innovation processes (Palmisano, 2006). An increasing trend of collaboration and outsourcing has been noted already in the last millennia (Chatterjee, 1996; Howells, 1999). This ongoing specialization in innovation processes in parallel to

the development towards IPR as a proper asset class, plus a need for a market for the asset class, has caused the necessity of highly specialized IPR related services. That, in turn, has led to the emergence of IPR service providers who felicitate the technology exchange on the innovation markets (Prilop et al., 2012).

The intermediaries' concept on technology markets itself is not a recent concept. It has previously been discussed in the context of innovation related transactions by Mittag (1985), Fu and Perkins (1995), Pollard (2006) and Tietze and Barreto (2007) who state that innovation intermediaries either support the whole innovation exchange process (e.g. auctions, intellectual property exchanges, matchmaking) or provide technology owners with particular services in certain stages of the transaction process (e.g. intellectual property valuation or drafting). Additionally, innovation market intermediaries are concerned with providing knowledge-intensive inputs to the IPR management processes (Howells, 2006). They can be assisting with a patenting process, extracting money from patents or being bridges for information (Czarnitski and Spielkamp, 2000). IPR service providers are innovation market intermediaries that provide services related to intellectual property rights. They facilitate more efficient market transactions of technologies, assist with the exchange of technical knowledge, and intellectual property by developing new IPR-related business models like patent trading platforms and IPR based loans or insurances (Prilop et al., 2012). The emergence of IPR service providers is an outcome of the IPR becoming and asset class and of the gradual maturation of technology markets. Although all the above-mentioned changes have contributed to the maturation of the technology market, it still has many market frictions (U St Gallen and Fraunhofer MOEZ, 2011). As long as the barriers to commercialization and entry exist and the market remains inefficient, there will be profit opportunities for IPR intermediaries and they will remain on the innovation markets (Hagiu and Yoffie, 2013). Therefore, another driver for the emergence of IPR service providers, besides patents evolving into an asset class and due to the organizational changes, are the current IP market frictions and barriers. IPR service providers have emerged to assist with various patent related processes and can benefit the market only if they prove to speed up the necessary processes for various parties. The more efficient the IPR service providers are, the more liquid the IPR market will become and the less IPR service providers should exist. Meanwhile, in the case of inefficient markets, the IPR

service providers could provide solutions or ease the situation by providing high-quality IPR services to technology companies (Tonisson et al., 2016).

Increasing the quality of the IPR services contributes to having a more efficient innovation ecosystem and could possibly help to mitigate the current market frictions (Tonisson et al., 2016). That makes the IPR service providers an important and interesting research topic. Current IPR markets have many serious problems (Millien and Laurie, 2008). If the IPR market problems would cease the number of IPR service providers would be expected to decline. However, the current IPR market is not in its best place and therefore IPR service providers play a vital role in facilitating the IPR market arrangements.

The core problems are that IPR market is illiquid, not transparent and highly inefficient (Tonisson et al., 2016). The IPR market is illiquid because the asset class cannot be easily sold or traded. It is difficult to sell or trade patents due to no clear IP valuation methods (Tonisson and Maicher, 2012). There are no commonly acknowledged IP valuation methods because of differences in patent quality and patent systems (U St Gallen and Fraunhofer MOEZ, 2011). IP-culture, and -awareness are low and consequently not all the patents are enforced or put into strategic use by technology companies. That, in turn, adds up to a low-efficiency issue. Asset (patent) liquidity, trade transparency, and market efficiency are the three core aspects of a well-functioning IPR market (U St Gallen and Fraunhofer MOEZ, 2011). In general, there are several issues related to the three core aspects that all are the cause of the malfunction of the IPR market. All the IPR market problems are interlinked and can be categorized into three segments. The first segment is the macro level IPR system issues that are related to regulatory framework and legal system. The meso level IPR market issues are failures in the setting where knowledge and patents get traded and/or reassigned. The micro level IPR service market issues are related to current shortcomings of exchange of expertise. These can be due to lack of certain services or the low quality of services provided. Increasing the IPR service quality has a positive bottom-up effect on mitigating the IPR system and market problems (see Tonisson et al., 2016). The positive effects are presented with arrows in the figure below:

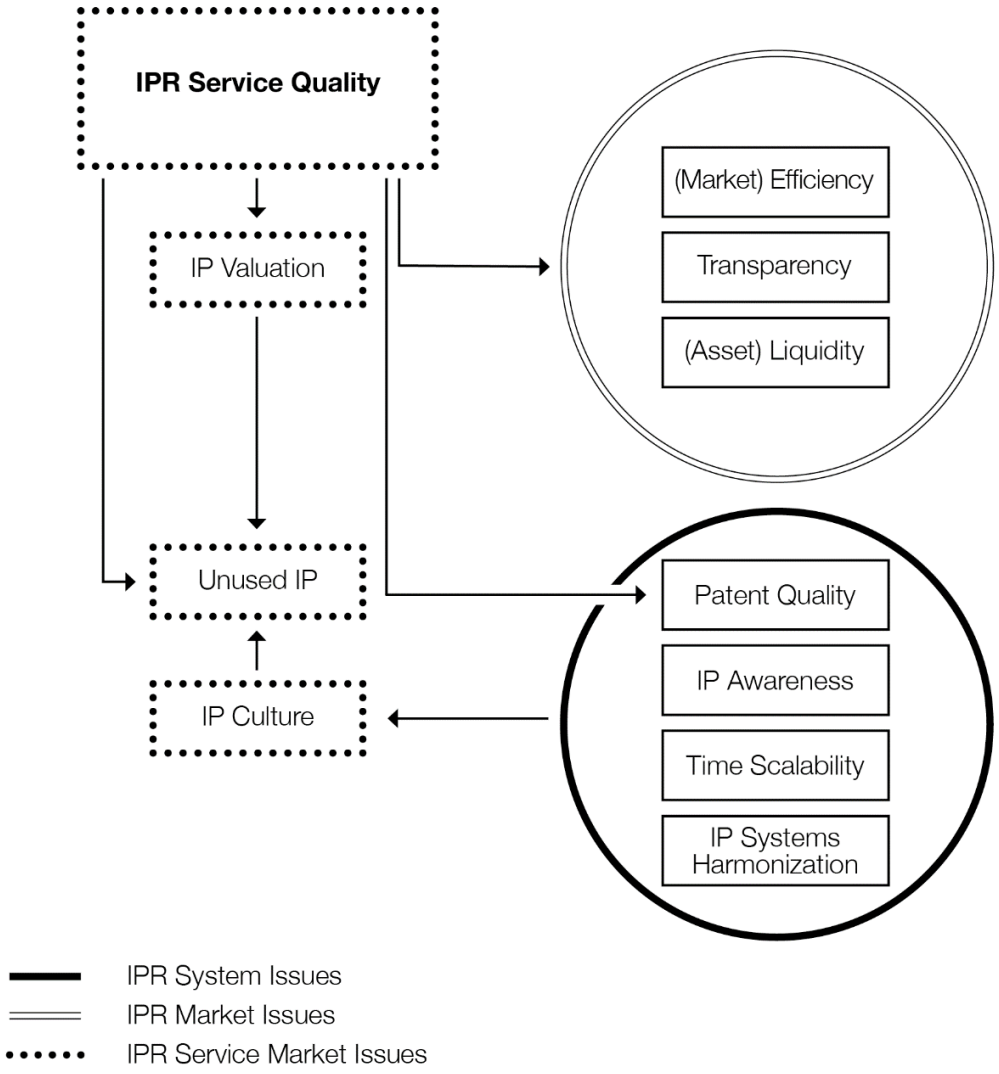

Figure 1 Illustration of "Positive causal effects between the 11 biggest problems in the IPR market"

Source: Tonisson et al. (2016)

An innovation system would benefit if the IPR market failures could be mitigated or even eliminated. The three interlinked IPR market problems on the illustration represent the core of a well-functioning IPR market, namely asset (patent) liquidity, trade transparency and market efficiency. These are necessary for any asset class market functionality. Based on previous research on the IPR market frictions topic, the core dysfunctionality of current IPR market could be addressed with an intermediary solution of increased IPR service quality and standard IPR valuation methods for the industry (U St Gallen and Fraunhofer MOEZ, 2011; Tonisson et al., 2016).

In order to increase the IPR services quality, an overview of these services is first necessary. There is no structured overview of all the IPR services provided for innovation market stakeholders. Common terminology for the various services does not exist. Due to that research gap, outsourcing IPR matters can be problematic. Most of the problems are related to lack of efficiency and transparency while outsourcing IPR related tasks. There is no index for various IPR services or a well-established systematic specification list for service providers with quality checks. The technology companies and the innovation market, in general, could benefit from an index of various IPR services with a common language and terminology to meet the commercialization needs of technology firms (Tonisson et al., 2016).

Therefore, the purpose of this thesis is to build a taxonomy for IPR services – Intellectual Property Services Classification (IPSC). The IPSC will hopefully ease the current difficult IPR market situation. The aim is to enable communication and information sharing between individuals interested in the same shared domain – IPR services. This is done by applying an ontology engineering process for the development of a taxonomy of IPR services. It is a starting point for the structuring of the IPR service market. A comprehensive taxonomy of all currently available IPR related services is the starting point of a more transparent and efficient technology market.

1.2. Explanation of Key Concepts

In this chapter, the fundamental definitions and terminology required throughout the thesis are introduced. This chapter provides the research framework for the whole thesis and therefore getting acquitted with the terms and concepts discussed here is necessary before proceeding.

The term **"Intellectual Property" (IP)** is used throughout the thesis. It refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. IP is divided into two categories: industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source; and copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as

drawings, paintings, photographs and sculptures, and architectural designs[1]. The narrower term **"Industrial Property Right" (IPR)** is more often used in this thesis. IPRs are legally protected inventions and can have commercial value when sold or traded (Monk, 2009). **"Intellectual Property Right"** is a synonym of this term. These rights include patents, industrial designs and trademarks as mentioned above. Within this research IPR concept mainly focuses on patents.

"IPR system" is the setting at the regulatory level where patents, copyright, and trademarks get created, filed, protected and exchanged. The whole IP system is disregarded as a scope of this thesis. IPR system is a combination of the legal framework for IP and the stakeholders in any region. For example, the Leahy–Smith America Invents Act (AIA) in the United States, local IPR service providers and the technology companies active in the region; and the Convention on the Grant of European Patents, local technology companies and IPR service providers in Europe. **"IPR market"** is the setting where knowledge and rights connected to that knowledge get traded and/or reassigned. It encompasses coordination of demand and supply of the asset class (patents). An IPR market is the place where IPR transactions and price setting take place (U St Gallen and Fraunhofer MOEZ, 2011). **"IPR service market"** is the industry level setting where IPR services that can be outsources for all IPR management and related processes are transacted. It is a subset of IPR market focusing only on exchange of expertize (Tonisson et al., 2016).

"IPR service providers" are stakeholders of the three above mentioned settings. They are by definition organizations which help the customers to protect, process and realize the value of their IPR. All the functions of the IPR service providers make transferring knowledge possible for innovation and development of new ideas and technologies. IPR service providers have emerged in order to facilitate more efficient market transactions of technical knowledge, technologies, intellectual property and particularly, patents. They do so by developing and executing new IPR-related business models like patent auctions or patent portfolio funds, see Prilop et al. (2012). All the economic activities of IPR services providers are the research topic of this thesis and are classified in the **"Intellectual Property Rights (IPR) related Services Classification" (IPSC).** The IPSC is a comprehensive classification of business activities in the market of intellectual

[1] World Intellectual Property Organization (WIPO) website, accessed 19 October 2016

property rights related services. It is a structured and well-defined set of IPR related services. It covers all the IPR related activities that technology companies can outsource to external players. The external players are the IPR service providers defined above. The IPSC is divided into following six main concepts:

"IPR Legal Services" – services involving legal or law related matters like an issue of patents, preparation of patent filing documents and litigation processes. There are various IPR service providers handling patents and patenting process on current IPR markets. Most of the services in this category require the involvement of an expert that has been validated in the IPR system (patent agent certificate or corresponding law degree).

"IPR Consultancy Services" – services that deal with various IPR aspects providing professional or expert advice in a particular area such as market specifics for a precise industry for patenting, technology and IPR roadmaps, and various qualitative and quantitative analyses for strategy decisions.

"IPR Matchmaking and Trading Services" – a pool of services that help with the process of arrangement of intellectual property rights related development needs of companies with available resources. Mainly because new technological products consist of hundreds or even thousands of patents, the producers do not hold all the rights and might be missing some pieces of IPR from its portfolio. In order to obtain the missing piece, the producer will have to license or buy the required IPR. There are specialists to whom these kinds of activities can be outsourced and their activities are categorized under "Matchmaking and Trading" services. They act as information intermediaries, for example by providing websites to establish online marketplaces where patents and ideas can be traded.

"IPR Portfolio Processing Services" – services related to the creation of IPR portfolios and partial management processes of the portfolio related to creating revenues out of IPR. This includes services for keeping IPR portfolio updated and well organized for tech companies.

"IPR-related Financial Services" – services that represent resource allocation as well as resource management, acquisition and investment related activities with regards to IPR. Some niche IPR services focus mainly on generating income from patent

monetization for the clients by creating strategic patent portfolios and licensing them to important stakeholders.

"IPR-related Communication Services" – services related to collective communication outlets or tools that are used to store and deliver information on IPR related topics or data, like publications, journals, blogs and educational materials. Additionally, the corresponding services of IPR related issues like unions and IP interest groups who offer services of community creating and IP culture building.

All the above-mentioned services and sub-services of the main concepts are categorized in the end result of this thesis – a taxonomy of all the services the **"IPR Services Categorization" (IPSC).**

The IPSC is applied in the **"IP Industry Base" (IPIB)**. The IPIB is a continuously extended database where more than 4,100 international IPR service providers have been mapped. The IPIB is developed by the Fraunhofer IMW Competitive Intelligence team. The IPIB uses the IPSC to define a service profile for each service provider (Prilop et al., 2012). This profile is the set of all services which are externally provided by a given company. The IPIB is a tool where the IPSC is integrated.

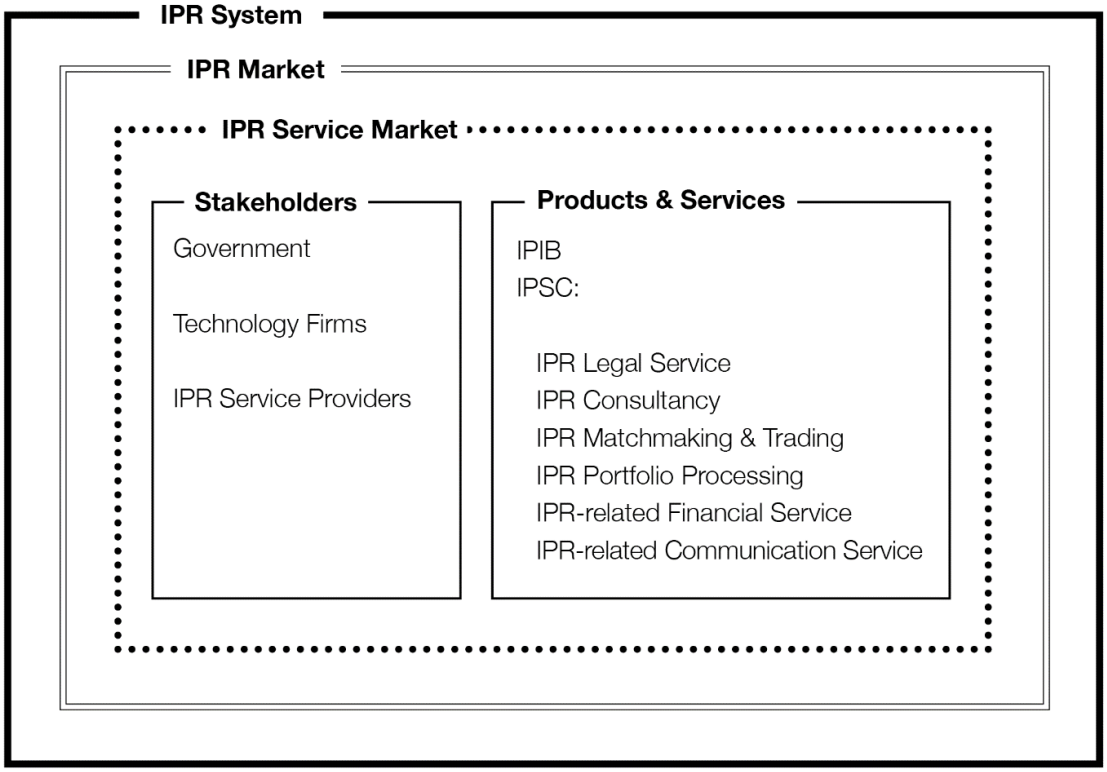

Figure 2 Illustration of Research Framework

"Methontology" and **"Competitive Intelligence"** are used for the methodology and IPSC implementation phases. Methontology is a classification system engineering process consisting of specification, knowledge acquisition, conceptualization, integration, implementation, evaluation and documentation phases (Fernández-López et al., 1997). Competitive intelligence the structured analysis of the company's competitive field by using external, authorized sources. Competitive intelligence is not only assembling and examining data, also the translation of this data into strategic and usable knowledge (Rothberg et al., 2004). Competitive Intelligence is the analysis of news announcements, analysts' reports, patents, company web pages, feedback from clients and suppliers, personality profiling of key individuals to evaluate the environment in which a particular organization functions. The analysis of the external sources of data is done to forecast future political, economic and rival actions that might have an impact on the organization (Tsitoura et al., 2012). For expressing and sharing the basic structure and content of concept scheme for the IPSC **"Simple Knowledge Organization System Reference"** (SKOS) model is used. Many knowledge organization systems, such as thesauri, taxonomies, classification schemes and subject heading systems, share a similar structure and are used in similar applications. SKOS captures much of this similarity and makes it explicit to enable data and technology sharing across diverse applications (Miles and Bechhofer, 2009). A controlled vocabulary is a list of terms which a community or organization has agreed upon. For example, legal-, consultancy-, matchmaking/trading-, portfolio processing-, financial-, and communication services related to IPR. A taxonomy is a controlled vocabulary organized in a hierarchy. For example, IPR legal-, financial-, and consultancy services are concepts of IPR services because all three are IPR services in general. Finally, a thesaurus is a taxonomy with more information about each concept including preferred and alternative terms. For example, IPR-related financial services represent resource allocation as well as resource management, acquisition and investment related activities with regards to IPR. All are alternative terms of IPR-related financial services.

1.3. Research Questions and Goals

IPR Service providers have emerged to assist the technology firm commercialization processes by offering specialized expertise related to various aspects of IPR management

and monetization. IPR service providers are organizations which help the customers to realize value from their IPR. However, the current roles and tasks of these service providers are quite diverse (U St. Gallen and Fraunhofer MOEZ, 2011; Yanagisawa and Guellec, 2009). In order to investigate these roles and tasks, a detailed classification of the existing and evolving IPR-related services is needed. Although there is already research on IPR intermediaries, an extensive categorization of IPR related services is missing. To eliminate this desideratum, the IPSC is built by using design science method.

Consequently, the following research goal captures the main research question of this thesis:

Main Research Goal: "A comprehensive classification of intellectual property related services"

The IPSC aims to have a coherent and complete classification structure of any activities related to the realization of IPR. The main goal of this thesis is to create a classification system by investigating the IPR service providers' activities. A comprehensive structured list of all current IPR services with descriptive definitions would ease the work of innovation market stakeholders and would be a step towards more efficient innovation markets. Finding a set of various terms used for IPR services by researchers, policy makers, technology firms and IPR service providers themselves is the first step towards the IPSC. The set of terms should be ideally analyzed and grouped so that for similar IPR related activity only one optimal term and definition remains. The IPSC is targeted to researchers, technology firms, policy makers and IPR service providers themselves. As a stable and accepted classification system, the IPSC should be applied by scholars and business analysts within their research on the IPR service market. The IPSC aims to assist innovation policy makers and technology producers in their everyday work by increasing the transparency of the IPR service market.

The IPSC should cover a wide range of services in order to be useful for various stakeholders. It should include services provided by private and public organizations as well as legal and marketing related services. Similar to any classification system it has to provide a framework for which related terms and definitions regarding the IPR service industry can be collected, presented and examined in an organized systematic manner.

In order to support the main research goal, the set of all IPR related terms are investigated. The aim is to create definitions for all the IPR related service terms currently found on IPR service market. Therefore, a supporting research question is:

Research Question 1 "What is the most comprehensive set of distinguished IPR services that can be identified on innovation markets?"

From the state of the art, it is clear that there exist numerous IPR related business models on innovation markets. All the activities which help the customers to realize the value of their IPR have never been collected together in one work before. First, a set of all activities which help customers to realize the value from their IPR is compiled.

Secondly, the aim is to create definitions for all the IPR related services currently found on IPR service market. Definitions should be created while avoiding overlaps. Once every IP service found on innovation markets and literature is clearly defined it is possible to analyze and present the information. Currently, only fragmented literature on the roles and activities of IPR service providers can be found. Information from all previously made analyses shall be extracted and compiled into two pools of information:

1. A set of distinguished IPR services
2. Corresponding definitions for every term identified previously

The second research question of this thesis aims not only to have definitions and common terminology for all the IPR related services but to also have a structure for the set of distinguished IPR services. Therefore, the second supporting research question is:

Research Question 2: "What is the concrete ontological structure for IPR services taxonomy based on the IPR services definitions?"

The aim is to create a concrete structure for the set of IPR services that can be retrieved and easily exported by categorizing the services by domain specifics into main categories and subcategories and sub-subcategories when necessary. This can be achieved by using Simple Knowledge Organization System Reference (SKOS) suggested by the ontological engineering methodology. Various definitions for the services provided suggest applying MECE framework for the clustering process of the various services. By using MECE framework, clearly defined services will be grouped into categories so that each category is separate and distinct without any overlap and all categories taken together should deal with all possible options without leaving any gaps. Therefore, an optimal

comprehensive set of distinguished IPR services can be identified and categorized thematically based on their definitions.

The ontological establishment for IPSC can be seen as a multi-level ordered directed tree where every IPR service will appear only once in the IPSC and therefore there are no overlaps. Main categories will be the top levels of domain specifications followed by narrower IPR services belonging to the same domain. The main categories can be distinguished via an analysis of various expertise to perform a certain group of IPR service and therefore will be thematically organized. The overall structure of the IPSC will be validated by literature overview and expert interviews. Subcategory services represent a narrower set of the same domain related services. None of the main categories can be categorized into the other main categories due to various know-how/knowledge requirements for performing the main category IPR services.

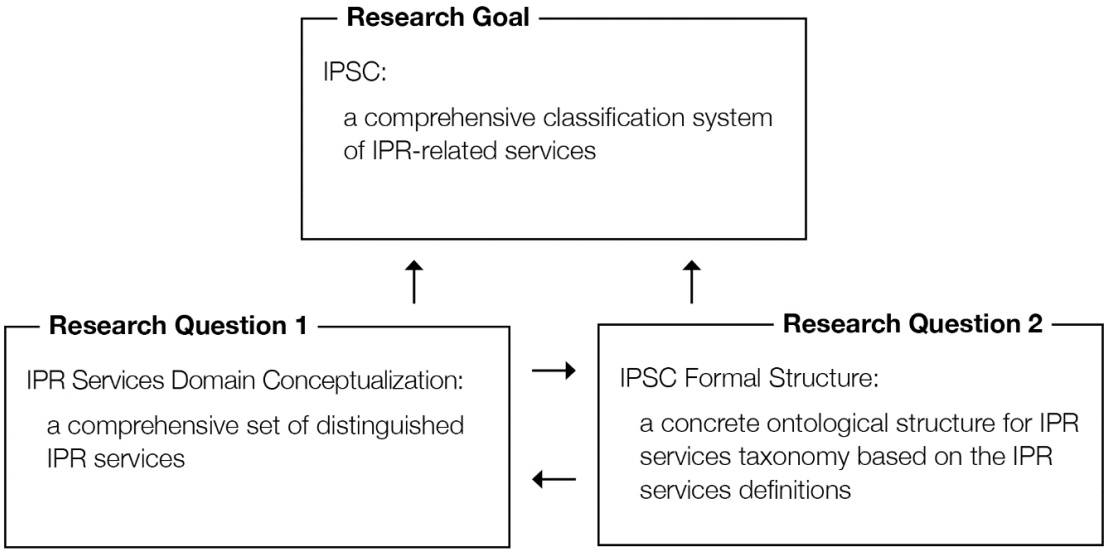

Figure 3 Illustration of Research Questions and Goal

In answering the research questions, the IPR services related information, organization, management, and understanding will be improved. This will be achieved by building a taxonomy based on the terms and definitions. In the information collection and evaluation processes, both research questions are challenged simultaneously.

1.4. Readers Guide

The remainder of this thesis is structured as follows. In the "Literature Review" paragraph the state of the art of technology and IPR market intermediation and ontology engineering science is presented. The methodology part describes the steps of ontology engineering in general. The "Methodology" chapter clarifies why this thesis follows a well-established methodology for ontology engineering, namely the methontology (Fernández et al., 1997). It presents the ontology engineering benefits with regards to other approaches (eg. clustering for typology building – a well-known approach in business science). The chosen methodology has eight steps. They are all discussed in separate subchapters and in the following order:

1. Knowledge Acquisition and Planning the IPSC
2. Specification
3. Conceptualization
4. Formalization
5. Integration
6. Evaluation
7. Documentation
8. Realization and Maintenance

The "Data Description and Collection Framework" chapter brings insights to the data, its collection framework, and analysis used within this thesis to realize the IPSC via a platform – the IPIB. In the chapter the IPR service providers' data and IPR services data, its collection framework, matching principles and validation steps are presented. The "Applying Methontology" chapter describes how the data and the ontology engineering process are applied. One by one the steps done in each of the above-mentioned eight stages are defined. More precisely, the specification document is assembled. IPR services related terms are conceptualized and the full IPSC with related terminology is presented in the formalization step. After the reader has been accustomed to the IPSC in the "Formalization" chapter the taxonomy is matched with existing classification systems in the "Integration" step. Evaluation procedures and documentation activities, as well as the realization of the IPSC and its maintenance, are

further elaborated in the last steps. "Realization" and "Maintenance" steps are combined into one paragraph within this research.

In the sixth section of this thesis, "Interview Results and Further Discussions", implications for industry are presented. The interviews conducted for this thesis suggested how the IPSC or tools incorporating the IPSC could contribute to the development of a more efficient innovation industry.

The "Contributions of the IPSC" chapter explains the expert opinions gathered throughout the interviews on how the IPSC could contribute to science and industry. Suggestions for further research are made in "Limitations of the IPSC and Future Work" chapter where IPSCs´ limitations are presented. Finally, a summary of findings is presented in the "Conclusions" chapter.

2. Literature Review

2.1. Intellectual Property Markets State of the Art Review

In the intellectual capitalism concept, which results from the combination of a capitalist economy and knowledge economy, intellectual capital has started to play a major role and is considered as the principal economic asset (Granstrand, 2000). The organizational changes in technology companies have been tremendous (Palmisano, 2006). Intellectual property rights management has become essential for successful corporate strategy and firms´ competitive positioning and for future income securitization (Hanel, 2006). Transferring knowledge often takes place via intellectual property rights - the principal economic assets for innovation.

During the last two decades, the IPR market has made tremendous changes. First, the change has happened in terms of structural changes in technology transfer and innovation processes. That means a shift towards fragmentation of the technology production and therefore some aspects of the technology transfer cycle are being outsourced (Palmisano, 2006). This new division of labor between technology owners, buyers and IPR service providers on the IPR-market level has an impact on the governance structures of IPR transactions on the micro level of the firm, more precisely, on how firms manage IPR transactions (Tietze and Herstatt, 2010).

With patents evolving into an asset class of its own and the structural change of the innovation processes another big shift has happened - IPR service providers have emerged in the last two decades (Tonisson et al., 2016). IPR service providers are intermediaries between the technology and related patent producers and consumers. These various practices are dedicated to extracting value or facilitating information or specializing in technology transfer processes. The emergence of these new intermediaries has caused an institutional change within technology companies. IPR service providers enable firms to outsource a wide range of activities associated with transactions of technologies, technical knowledge, and intellectual property and particularly, patents. These intermediary firms are developing new IPR-related business models like patent auctions and patent portfolio funds, see Prilop et al. (2012).

In the context of technology and innovation systems, different researchers have discussed different functions, relationships and processes of intermediaries. The intermediary concept itself is not new. Technology market intermediaries create market liquidity and ease technology transfer processes through various functions they deliver and are an important subject for research (Howells, 2006). Their main roles according to literature are to identify, locate, absorb and collect knowledge that is relevant for the innovation system, to adapt it to new applications in sectors or industries and to transfer it between stakeholders (Stankiewicz, 1995; Hargadon and Sutton, 1997).

Howells (2006) work states that there are two types of literature on innovation market intermediaries: a) literature focusing on intermediaries as organizations and b) intermediation as action. Somewhat similarly Winch and Courtney (2007) distinguish between organizations whose primary aim is to undertake an intermediary role and those that perform IPR-related activities as a by-product of their main activities. Innovation support centers and organizations supporting innovation networks are seen as organizations whose primary aim is to undertake an intermediary role. Consultancy firms and research commercialization offices of universities can offer IPR services as a by-product of their main activities offering intermediation as an action or service. Combining Howells (2006) work and more recent research on innovation intermediaries the literature that looks at the intermediary organizations on innovation market can be summarized with the following:

Research	Organizations as	Roles
Watkins and Horley (1986)	Intermediaries	Explores role of intermediary agencies support technology transfer to small firms
Mantel and Rosegger (1987)	Third parties	Persons or organizations that intervene in the adoption decisions of others
Aldrich and von Glinow (1992)	Brokers	Agents facilitating the diffusion of in social systems of new ideas from outside the system
Seaton and Cordey-Hayes (1993)	Intermediaries	Examines the role of intermediaries in technology exploitation
Braun (1993)	Intermediary agencies	Role of mission agencies in formulating research policy
Callon (1994)	Intermediaries	Role of intermediaries in effecting change within science networks and local collectives
Bessant and Rush (1995)	Consultants as bridge builders	Role of independent consultants as bridge builders in the innovation process
Stankiewicz (1995)	Intermediary firms	Adapt solutions available in the market to the needs of the individual user
Shohert and Prevezer (1996)	Intermediaries	Public and private organizations that act as agents transferring technology between hosts and users
Guston (1996)	Boundary organizations	Role of boundary organizations in technology transfer and "co-production" of technology
Turpin et al. (1996)	Bricoleurs	Agents seeking to develop new applications for new technologies outside their initial development field
Lynn et al. (1996)	Superstructure organizations	Organizations that help to facilitate and coordinate the flow of information to substructure firms
Hargadon (1998)	Knowledge brokers	Agents that help innovation by combining existing technologies in new ways

Research	Organizations as	Roles
Van der Meulen and Rip (1998)	Intermediary level bodies	Help orient the science system to socio-economic objectives
Howells (1999)	Innovation intermediaries	Proactive role that certain types of service firms play as intermediaries within innovation systems
Provan and Human (1999)	Technology brokers	Actors filling gaps in information and knowledge in industrial networks
McEvily and Zaheer (1999)	Regional institutions	Provide surrogate ties by serving as functional substitutes for a firm's lack of bridging ties in a network
Cash (2001)	Boundary organizations	Role of boundary organizations in technology transfer
Millar and Choi (2003)	Knowledge intermediaries	Organizations that facilitate a recipient's measurement of the intangible value of knowledge received
Szogs et al. (2008)	Mediator organizations	Role of mediator organizations in the making of innovation systems
Yanagisawa and Guellec (2009)	IP specialist firms	Role of new entities focusing on patent-related transactions
Tietze (2010)	Technology Market Intermediaries	Role of supporting technology firms with managing transactions
Hagiu and Yoffie (2013)	Novel patent intermediaries	Economic role of new patent intermediaries in the patent market and the effects on innovation
Millien (2013)	IP Intermediaries	Firms that attempt to perform one or more services or offer one or more products that connect the IP creators and the IP consumers

Table 1 Table of Literature Overview "Intermediaries and Organizations" based on Howells (2006) summary including more recent works

In some of the literature, just two types of technology market intermediaries have been distinguished. The divide is dependent on the scope of their activities. According to

Tietze (2010), these intermediaries either assist companies with the whole intellectual property transaction process (patent agents) or offer specific services that are just a part of the whole transaction process. The last ones offer assistance in certain stages of the transaction process (Tietze and Barreto, 2007; Tietze and Herstatt, 2010). Szogs et al. (2008) divided the set of technology market intermediaries into two pools differently. According to the study, there are two distinguished groups: the information scanning and information gathering activities and the ones carrying out communication functions (Lynn et al., 1996; Wolpert, 2002). Combining Howells (2006) work with more recent research on the state of the art on the intermediation activities the literature on technology markets would include:

Research	**Activities**	**Roles**
Pilorget (1993)	Innovation consultancy services	Role of consultancy firms specifically to promote innovation; involves a variety of actors including consultancy firms and intermediary agencies
Hargadon and Sutton (1997)	Technology brokering	Technology brokering is where an organization routinely creates new products by making connections between existing solutions in other sectors or technologies
Czarnitski and Spielkamp (2000)	Innovation bridging	Provision of knowledge or services that are complimentary to firms
Popp (2000)	Innovation business service providers	Innovation services dedicated to exchange of information
Wolpert (2002)	Knowledge brokering	Intermediaries that facilitate the exchange of information about innovation amongst companies

Table 2 Table on summary of Literature Overview "Intermediation" based on Howells (2006) summary including more recent works

Indeed, in existing literature different roles and activities of IPR service providers have been described via various case studies. Howells (2006) literature overview on intermediation and intermediaries as organizations are both relevant to understand the full state of the art review. Due to the fact that the interpretations of roles are diverse (U St. Gallen and Fraunhofer MOEZ, 2011) different synonyms for IPR intermediaries

have been used. Researchers in the field discuss innovation market intermediaries as third parties (Mantel and Rosegger, 1987), intermediary firms (Stankiewicz, 1995), bridgers (McEvily and Zaheer, 1999; Bessant and Rush, 1995; Sapsed et al., 2007), brokers (Provan and Human, 1999; Hargadon and Sutton, 1997; Batterink et al., 2010; Klerkx et al., 2009), innovation business service providers specifically for exchanging information (Popp, 2000), innovation consultants (Klerkx and Leeuwis 2009), knowledge-intensive business services (KIBS) firms (Howells, 2006) and superstructure organizations (Lynn, 1996).

As seen from the summarizing papers above, patent and IPR intermediaries are more of a research topic for the last decade. Intermediation on innovation markets has been widely discussed in the literature since the 1980s. Mantel and Rosegger (1987) are one of the first to look at the topic by studying the roles that third parties played in the innovation diffusion process. They analyze the functions of supporting the decision-making of whether to adopt or not; a specification writer or standard setter; and an evaluator of the technology once it was in the market. Hargadon and Sutton (1997) analyze in their study how brokers, as agents, facilitate the process of knowledge and technology transfer. They do so by observing the brokerage service across people, organizations and industries by looking at case studies. They conclude that brokering is more than just a linking role. Brokering additionally helps to transform the ideas and knowledge being transferred. They identify the role of a broker as a knowledge repository. That pool of knowledge is used by brokerage workers to provide solutions that are new combinations of existing ideas to their clients. They do not see brokers as just some supporters of making connections between various stakeholders (Howells, 2006). Stankiewicz (1995) investigates intermediary firms that help connect stakeholders. Lynn (1996) investigates innovation communities defined as superstructure organizations. That research looks at a group of organizations that help to associate and transform connections within an innovation system. The roles of these organizations are to provide collective goods to their clients by facilitating and coordinating the flow of information to technology producers. This study concludes that such service providers may be both public and private organizations. That part of the literature observes innovation intermediaries as organizations.

The specific roles of the intermediaries have been addressed in different research fields, ranging from the literature on technology transfer and dissemination of innovation to

innovation management, systems of innovation literature and knowledge intensive business services firms (Howells, 2006). Much of the literature on intermediation roles is rather conceptual and case specific. It discusses intermediation in a particular context of transactions. Such conceptual and case specific research includes Lien (1979), Czarnitzki et al. (2001), Birkenmeier (2003), Krattiger (2004). Fu and Perkins (1995) identified the parts of innovation transfer processes that involve the help of external experts (including evaluation, training, financial negotiations, legal-, technology-, strategy negotiations, tailoring technology, approaching and identifying prospects). Pollard (2006) to some extent similarly discussed the role of various service providers in the technology transfer process. He examined processes of innovation in networks involving universities, research and development centers, and business firms in an international perspective.

The general role of these service providers is to compensate in different ways for inefficiencies in the IPR market (Sapsed et al., 2007), facilitating the exchange of ideas and knowledge transfer between different stakeholders of the system that otherwise would not collaborate. An innovation intermediary is defined by Howells (2006) as an "organization that acts as an agent or broker in any aspect of the innovation process between two or more parties by scanning, gathering and communicating information; linking together actors and brokering relationships; and supporting and facilitating steps in the innovation process of firms and between firms, including evaluation, accreditation, and commercialization" (Howells, 2006). Intermediaries are thus defined by what they do or which roles they perform and not by their characteristics.

More recent works (e.g. Hagiu and Yoffie, 2011; Millien and Laurie, 2008) have investigated further the types of intermediary roles. Furthermore, these recent works have focused on intermediaries specializing in services related to patents and patenting. This can be seen in the two tables above summarizing most of the literature on intermediation. Research published in the last decade has studied the intermediation related to IPR and patents explicitly.

More recent works by Yanagisawa and Guellec (2009); Millien and Laurie (2008); Hagiu and Yoffie (2013) are comprehensively looking at case studies and investigating the roles of IPR service providers. Yanagisawa and Guellec (2009) distinguish thirteen different roles for the forty-two case studies. Research done by Millien (2013) moves

towards structuring the IPR service market. Millien (2013) distinguishes nineteen various IPR services on IPR markets. The exact business models and tasks of some of the IPR market intermediaries are examined in an organized and analytical way by Hagiu and Yoffie (2013); Millien (2013) and by Yanagisawa and Guellec (2009). These papers are considered the starting points of research in patent related services provided on innovation markets.

State of the art review on innovation intermediaries covers intermediation as well as intermediaries as organizations. Throughout the literature, intermediaries and more precisely IPR service providers are mainly defined by what they do – what processes they offer. Therefore, the focus is on intermediation – services provided by the innovation market Intermediaries. As suggested by previous studies (Howells, 2006) a more specified account of the functions and different roles still needs to be researched regarding intermediation and the role of IPR service providers. This research is an attempt to do so.

2.2. Ontology Engineering State of the Art Review

The state of the art is constantly moving towards creating a better understanding of the various IPR related services offered on the IPR market. The availability of a formal classification for IPR services and consequent benefits greatly reduces the barrier of entry in the IPR service market for all stakeholders. The benefits, such as the possibility of conducting automated outsourcing of IPR related activities, are especially useful for non-experts or newcomers. It helps to save resources and furthermore the establishment of a more precise and controlled IPR services related vocabulary among the expert domains involved in the IPR service market increases IPR awareness (Tonisson et al., 2016). Nevertheless, a detailed and comprehensive categorization of all currently available IPR services is missing.

A well-known approach for classification system development is ontology engineering. The word ontology refers to a set of representational terminology. It is the study of types of data for a certain domain of disclosure. Ontologies can be used as influential components in knowledge management by finding an explicit agreement on common ontological commitments which means having the same understanding of a shared terminology (Neches et al., 1991; Gruber, 1995; Uschold and Gruninger, 1996).

Additionally, ontologies have a huge potential to improve information organization, management, analysis and representation (Zhang et al., 2012).

An ontology might be considered the most complete and powerful model for information representation where domains and their relations are presented. Taxonomy is a simpler version of an ontology that is a classification of concepts described by terms according to legacy (Ullrich et al., 2003). Ontology engineering needs first abstract models and concepts to represent its core theories and how various categories are related. In general ontologies fulfill these five requirements:

1. provide contextual knowledge for a query expansion or query rewriting (Bodner and Song, 1996; Sintek et al., 2000);
2. facilitate natural language access (Guarino et al., 1999);
3. provide views and navigation structures for manual browsing (O'Leary, 1998; McGuiness, 1998);
4. enable management of non-textual media (Khan and McLeod, 2000); and
5. support retrieval and integration of information from different, distributed sources (Staab et al., 2000a; Heflin and Hendler, 2000).

There are various ontology development methods presented by literature. In 1990, Lenat and Guha published the general steps and some interesting points about the Cyc development. Back in 1995 Uschold and King presented a process of building ontologies. Their work was extended in 1996 by Uschold and Gruninger. Bernaras et al. presented another method in 1996 for ontology building in the domain of electrical networks as a part of the Esprit Kactus project. None of these methods mentioned are satisfactory for scientific work. The first method used that is applicable for research and so far the most complete method for ontology engineering is methontology (Gomez-Perez et al., 2004).

The methods presented back then are insufficient and the relationships between various stages are unspecified. In 1996, guidelines of ontology designing and developing were proposed as follows:

1. Identifying the purpose of it, its scope and domain, determining the users and developers

2. Construction
3. Evaluation
4. Documentation

One of the more recent works of Di Maio (2009) describes the essential activities for Ontology Engineering without describing in detail a sequence to perform. The guidelines of ontology designing and developing are proposed as follows:

1. Identifying Stakeholders
2. Defining the Purpose / Goal of the Ontology
3. Outlining Requirements
4. Identifying and Surveying Existing Knowledge Sources
5. Scoping the Ontology
6. Evaluation and Testing
7. Definition
8. Implementation
9. Deploying
10. Testing and Validation
11. Publishing
12. Maintenance and Reuse

Many authors do agree that the approaches for building domain – and cross-domain ontologies are usually too specific and incomplete (Arnold, 2015). From the methodological point of view, there is a problem that there is no generally accepted patterns or phases for building ontologies (Fernandez et al., 1999; Uschold and Gruninger, 1996). Despite the fact that great quantities of ontologies have already been developed by different communities as Chemistry (Gomez-Perez et al.,1996) or Business Process Modeling (Fox and Gruninger 1998), under different approaches and using different methods and techniques, there is little consensus about the most optimal methodology for the development process (Fernandez et al., 1997). Besides that, there is a lack of a systematic explanation of how the theoretical approaches might be used

pragmatically. Therefore, it requires excessive evaluation and validation to qualify as a high-level scientific activity.

Examples of traditional methodologies are Uschold and King's method (Uschold and King, 1995), Fox and Grüninger methodology (Fox and Gruninger, 1998) and methontology (López et al., 1999). A complete one is methontology (Gomez-Perez et al., 2004). According to the literature on ontology engineering, most of the approaches follow these general steps (Pâslaru-Bontaş, 2007):

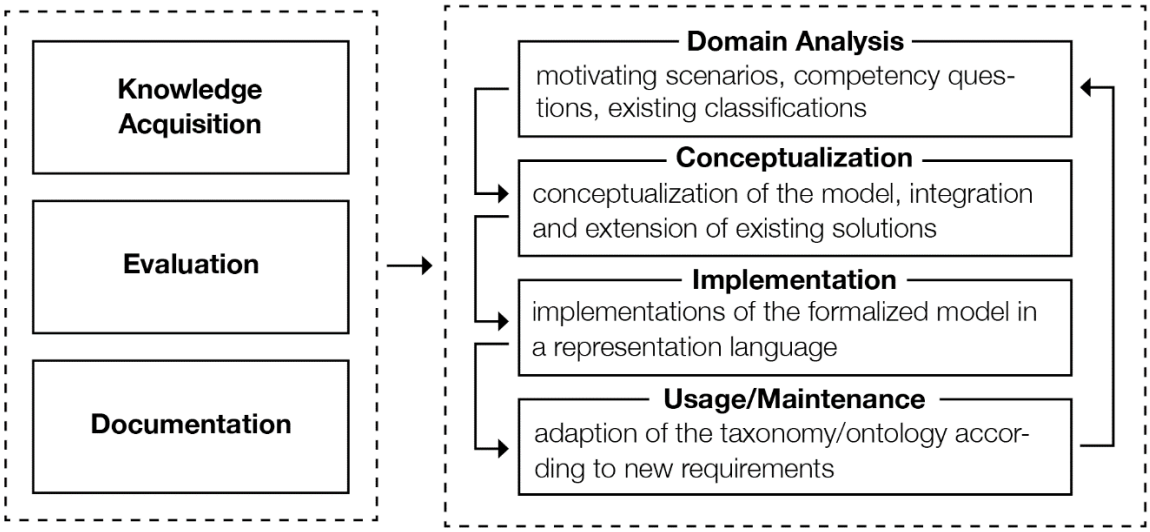

Figure 4 Illustration of General Steps of Ontology Engineering

Source: Pâslaru-Bontaş (2007)

Methontology is an ontology engineering method with nine steps that is considered most complete (Gomez-Perez et al., 2004). It is used for creating ontologies from scratch. Fernandez (1999) proposed several steps in his work that are similar to Gurninger and Fox (1998) and Uschold and Gruninger (1996). The difference is that methontology introduces evaluation and documentation stages to the whole ontology engineering process. It supports the ontology lifecycle process based on a prototype that changes throughout the engineering process. Adjusting changes to the prototype throughout the stages makes introducing any change to the ontology easier when compared with other methods that support top-down, middle-out, or bottom-up approaches (Fernández-López et al., 1999).

3. Methodology

3.1. Methontology

In the past decade, the number of applications for engineering classification systems has been growing (Guarino, 1998; Fensel, 2004). The type of classification system based on human judgment is generally known in business research as typology. A taxonomy is typically an empirically (quantitatively) derived classification system applied in natural sciences and business information systems research. A taxonomy can be achieved by design science or by cluster analysis. Clustering is the task of grouping a set of services in such a way that services in the same group (called a cluster) are more similar. Clustering is a technique of statistical data analysis. The classification developed within this work is based on quantitative work and human judgment. The core idea within this work is a formal, explicit specification of the conceptualization of the IPR services domain that can be best achieved with a taxonomy based on an ontology engineering process (Gruber, 1991; Van Heijst et al., 1997). The IPSC ideally consists of a set of various IPR related services and a hierarchy for those services. This thesis is not sufficient to rationalize the sourcing decisions for IPR services or interlinked relationships between the various IPR services and stakeholders of the IPR service market. Therefore, a taxonomy of IPR services is developed by applying an ontology engineering process. That kind of specific domain related taxonomy can be achieved best by using design science such as ontology engineering (Fernandez et al., 1997). Since ontology engineering has been gaining more and more attention in science and the purpose of ontology engineering serves the goal of building clear definitions of various services offered on the markets and structuring these definitions, this approach has been chosen as a methodology for this thesis. The domain of disclosure will be the IPR services.

Competitive intelligence is the structured analysis of the IPR service providers competitive field by defining, gathering, analyzing, and distributing related data. It is done by using external, authorized sources like websites and publications. It is applied for collecting knowledge for the domain. With the on-going rise of service-oriented business models, the need for competitive intelligence for IPR service industries increases (Nemutanzhela et al., 2011). Competitive intelligence is assembling and examining data and also the translation of the collected data into strategic and analytical information

(Rothberg et al., 2004). Therefore, it serves the goal of organizing the pool of terms used for IPR service providers into a hierarchical system well. The competitive intelligence method is "the use of external sources of data (news articles, data reports, patents, company web pages, feedback from stakeholders, interviews) to evaluate the environment in which organizations function and to forecast future political, economic and environmental shifts which might have an impact on the organization" (Tsitoura et al., 2012).

For organizing the terminology and definitions data for the IPSC, SKOS is applied. SKOS is an area of work which develops specifications and standards to support the use of knowledge organization systems (KOS) such as thesauri, classification schemes, subject heading systems and taxonomies within the framework of the Semantic Web. Thesauri means controlled terminology. Thesauri helps to minimize semantic uncertainty by ensuring standardization and consistency of the definitions of the various categories in the IPSC. The service descriptions found with the help of the Internet is the first step towards collecting a pool of terminology for the set of IPR services. Throughout study IPR service providers' websites filled with various descriptions of the services that they provide are investigated. However, the descriptions of services provided are not homogeneous and therefore the taxonomy engineering for IPR services needs a constant evaluation and considerable analysis throughout the methodology implementation.

For creating a hierarchy based on the definitions of all of the distinguished IPR services, MECE framework is applied. MECE framework is used for clustering process of services (Spencer, 2013). MECE is a framework used to organize information which is:

- mutually exclusive, meaning that information should be grouped into singular categories so that each category is separate and distinct without any overlap
- collectively exhaustive, meaning that all categories taken together should deal with all possible options without leaving any information gaps. For the services grouping, the IPSC MECE framework is applied

Because of its nature MECE framework serves the goal of having one category for one IPR service in the classification with no overlapping activities. The aim is to create a comprehensive classification where all of the categories cover the whole IPR service market.

The goal of this thesis is not to investigate the interlinked relationships between the distinguished sets of IPR services. The goal is to give the whole set of IPR services a clear structure and definition for each domain. All the ontology engineering requirements are fulfilled for the IPSC engineering process while not investigating the IPR services relations. Ontology engineering process is applied for the purpose of building a taxonomy. The aim of introducing a taxonomy of IPR services is to eliminate or at least reduce the conceptual and terminological confusion and to move towards a common and shared understanding regarding the domain. Applying ontology engineering process for creating a taxonomy can improve communication, sharing, interoperability and usability of IPR related services due to the characterization of ontologies (Studer et al., 1998; Uschold, 1998). The IPR services are bundled and matched according to various dimensions of information on the thematic differences.

The methontology engineering process itself consists of the following phases: specification, knowledge acquisition, conceptualization, integration, implementation, evaluation and documentation (Fernández-López et al., 1997). Within this work, the realization and maintenance phases are combined because more recent works of ontology engineering suggest combining of the maintenance and usage steps (Pâslaru-Bontaş, 2007). Evaluation, knowledge acquisition and documentation are suggested to be carried out throughout the various steps by most of the literature on ontology engineering (Arnold, 2015; Pâslaru-Bontaş, 2007). The logic of the steps and order of the phases with corresponding chapter number are presented below:

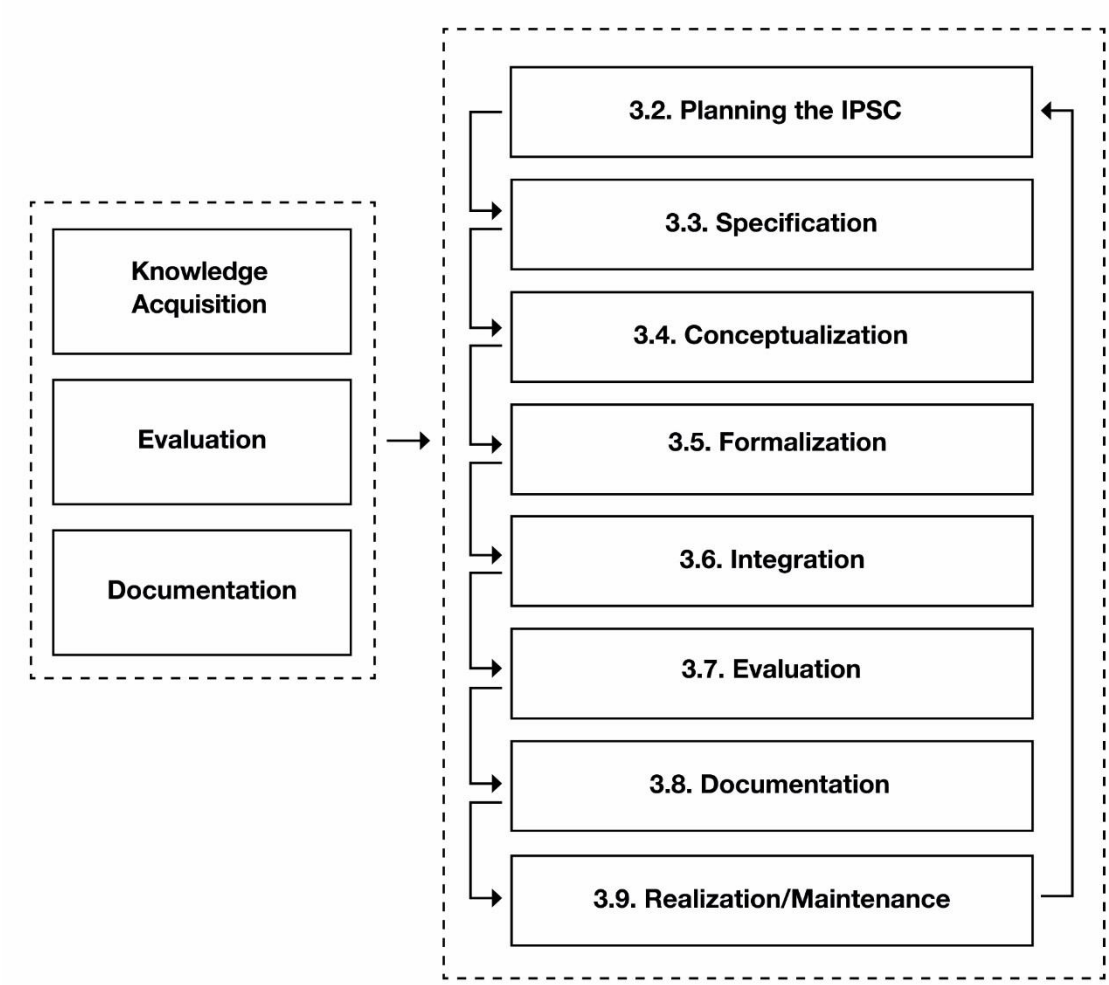

Figure 5 Illustration of Methontology: from Ontological Art Towards Ontological Engineering
Source: Fernández-López et al. (1997)

3.2. Planning the IPSC

Within the "Planning the IPSC" phase an initial set of IPR services is extracted by extensive desk research, by investigating media, IP service providers' websites, literature on IPR intermediaries' topic and by conducting interviews. The planning for the right wording for definitions and possible structure for the IPSC is done by using sense making (Weick, 1995) and qualitative content analysis method. (Mayring, 2000). The knowledge acquisition phase starts with the collection of qualitative data (interviews). As a researcher reviews the data collected, repeated ideas, concepts or elements emerge. These concepts are tagged with "keywords", which are extracted from the data. When data is collected, and when the new data is reviewed, "keywords" are

grouped into concepts, and then into categories. Sense making is applied throughout the analysis of expert opinion in the various domain related summits and conferences. This applied method is a collaborative process of creating shared awareness and understanding out of different individuals´ perspectives regarding the domain of interest (Weick, 1995). The qualitative content analysis method by Mayring (2000) produces information only on the particular cases studied. It is applied when analyzing publications, websites of various IPR service providers and literature on IPR services. Meaning one IPR service provider is at the focus and for that specific case study the Mayring (2000) method is applied. Conclusions made for one case study or concept by this method are not valid for other case studies or concepts – any other general conclusions are considered the proposition.

3.3. Specification

The objective of the specification phase is to produce either an informal, semi-formal or formal specification document written in natural language, using a set of intermediate representations or using competency inquiries. Methontology proposes that at least the following information be included (Arnold, 2015):

- The purpose of the taxonomy, containing its planned uses, settings of use, users, etc.
- Degree of formality of the applied taxonomy, depending on the formality that will be used to codify the terms and their meaning. Uschold (Uschold and Gruninger, 1996) classifies the level of formality into a range of highly informal, semi-informal, semi-formal or rigorously formal. Wand and Weber restrict to three levels of formality (2002): informal, semi-formal, and formal ontologies. Most of the currently available sources usually associated with the word "ontology" can be ordered to the category of semi-formal models (Sicilia, 2006). The classification depends on whether terms and their meanings are codified in a language between natural language and a rigorous formal language.
- Scope, which includes the set of terms to be represented, its characteristics and granularity.

The IPR services ontology requirements specification document structure is the following:

IPR services ontology requirements specification document	
Domain	For what is the classification system is created for? In Zhang et al., (2012) an example an ontology was created for intellectual property rights protection. Or in the domain of electrical networks as a part of the Esprit Kactus project (Bernaras et al., 1996).
Purpose	Whom does it serve? Is it meant for law students, C-level company managers, innovation researchers, governments etc.?
Level of formality	Informal, Semi-formal or Formal.
Scope	How complete shall the classification system be? Will it map also the interrelationships (if not the correct term is taxonomy), or is it limited to a narrower subset within the same domain (eg. looking just at law related IPR services)?
Principal Sources of Knowledge	Origin of appropriate information. Where does the data for the process of assembling the classification system come from (eg. literature, specific databases, crowdsourcing, interviews etc.)?

Table 3 Illustration of Ontology Requirements Specification in the IPR Services Domain

The approach is to index the contents of the IPSC using appropriate definitions and terms, rather than classification codes.

3.4. Conceptualization

In the conceptualization phase, general logic of the categories of the taxonomy are presented. The exact order can be achieved in the next steps, but the concepts of various areas of the same domain have to be classified (Gomez-Perez et al., 2004). To conceptualize the domain of interest, domain knowledge is investigated. The domain

knowledge has to be structured in a conceptual model that describes the IPR related services provided in terms of the domain vocabulary identified above in the ontology specification activity. MECE framework is suggested for clustering process (Spencer, 2013) and is applied to list domain related terms that should be grouped together according to the similarity of outputs of the various services provided. Natural language can be used throughout building process of the taxonomy.

3.5. Formalization

In order to represent the definitions for the services in the formalized IPSC, SKOS language is suggested (Miles and Bechhofer, 2009). The SKOS data model provides a standard, a low-cost migration path for transferring existing knowledge organization systems to the Semantic Web. SKOS also provides a lightweight, intuitive language for developing and sharing new knowledge organization systems. It may be used on its own, or in combination with formal knowledge representation languages such as the Web Ontology language (OWL). SKOS can be used on its own when the formalization or implantation step does not require OWL[2] representation. As an end result of formalization step, top categories can be defined which can be further divided into several subcategories using MECE framework.

3.6. Integration

The integration phase includes the work of the possible matching of various taxonomies regarding the same subject. An integration or harmonization of the taxonomy with other classification systems is useful to align the information processing and representation (Arnold, 2015). In the IPSC case works done on IPR services by Millien (2013), Hagiu and Yoffie (2013) and an IPR service providers classifications according to their function on the market proposed by Yanagisawa and Guellec (2009) as suggested by the literature overview above should be matched with IPSC.

[2] The Ontology Web Language (OWL) is a set of markup languages which are designed for use by applications that need to process the content of information instead of just presenting information to humans.

3.7. Evaluation

Evaluation of the taxonomy should take place throughout the research process as suggested by the framework for evaluating knowledge sharing technology (ontologies, taxonomies, and documentation) presented by Gomez and Perez and colleagues (Gomez-Perez et al., 1995). Evaluation means to carry out a technical judgment of the taxonomy, their language and documentation with respect to a frame of reference (in this case the requirements specification document - Table 3) during each phase and between phases of their lifecycle. Within the chosen methodology it means empirical validation. Namely, data-based evaluation of the taxonomy correctness and completeness and additionally peer reviews of the dataset of terms and definitions used.

3.8. Documentation

Documentation throughout the process is essential. There are no commonly agreed – upon guidelines on how to document taxonomies (Fernandez et al., 1997). In many cases, the only documentation available is in the taxonomy itself. Documentation includes the natural language text, and papers published in conference proceedings and journals. The methontology approach includes documentation as an activity to be done during the whole ontology development process and it has to be done throughout the taxonomy development steps (Arnold, 2015).

3.9. Realization and Maintenance

Within the methodology process, the two last steps of methontology are joined as suggested my more recent research (Pâslaru-Bontaş, 2007; Di Maio, 2009). In the realization phase, the taxonomy is applied, and the process, as well as implementation outcome, are employed. Maintenance rules for the taxonomy are also clarified within this step. Suggestions for the preservation of the taxonomy and implementation of the taxonomy are presented.

4. Data description and collection framework

IPR services providers that provide a distinct function or role that can be classified in the IPSC are investigated within this thesis. This research is built on scattered overviews of IPR service market by combining previously published works and the information from forty-two interviews and one-day workshop carried out for the purpose of this thesis. The domain terminology acquired via interviews, desktop research and IPR conference proceedings was the first dataset for IPR services that was gathered in the knowledge acquisition phase. Additionally, the terminology dataset was assembled by state of the art research on IPR services as intermediation services on innovation markets. The set of domain terminology was divided into six various groups in the beginning of 2012. During the fourth workshop "Patent Intelligence for Policy Support" organized by the European Commission Joint Research Centre, Institute for Prospective Technological Studies (IPTS)[3] the six top-level categories were assembled, defined and presented. The overall hierarchy of the IPSC was not fixed at that time. Feedback was collected from the workshop participants and the updated IPSC was validated by twenty-six telephone interviews. Summary of the interviews were transcribed from interview recordings and by "keyword" search the new set of terminology data was applied for the IPSC.

A dataset of 600 IPR service providers was organized according to an upgraded structure of IPSC by the beginning of 2013. The dataset and the structure of the IPSC were thereafter discussed in Paris at the OECD "Growth, Innovation and Competitiveness - Maximizing the Benefits of Knowledge-Based Capital" conference in February 2013[4]. By summer 2013 the dataset had grown to 850 IPR service providers. The corresponding IPSC was discussed at the "IAM IPBC – The Annual Event for Global IP Leaders in Boston"[5], where suggestions for new service providers to be added and service definitions to be edited where implemented to the IPSC by the end of the year. In 2014 the changes were validated by telephone interviews with 16 IPR experts. Once more the interviews were recorded, summarized and a "keyword" search was applied to update the terminology dataset.

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[3] The European Commission Joint Research Centre, Institute for Prospective Technological Studies (IPTS) 4rd Workshop "Patent Intelligence for Policy Support" - Seville, 24-25 May 2012

[4] OECD "Growth, Innovation and Competitiveness - Maximizing the Benefits of Knowledge-Based Capital" in Paris 13-14 February 2013

[5] The IAM IPBC – The Annual Event for Global IP Leaders in Boston, 9-11 June 2013

In 2015 an IPR expert group gathered at Imperial College for a one-day workshop dedicated solely to updating and editing the terminology dataset and for finalizing the list of services and definitions. Based on the recommendations, additional data on more than 2,000 IPR service providers were collected. In total by the beginning of 2015, a distinguished set of seventy-two various terms for IPR service providers were identified with the help of the expert statements.

The terminology is explained in the "Formalization" chapter where each IPR service is elaborated based on literature review, interviews, and results from conference proceedings. Consequentially the terminology dataset suggests:

1. distinguished IPR service,
2. its formal definition,
3. a numerical index that is used for the definition and term in the IPIB

To date, a dataset of 4,104 IPR service providers has been analyzed. All the companies providing IPR related services are mapped worldwide in the IPIB.[6]

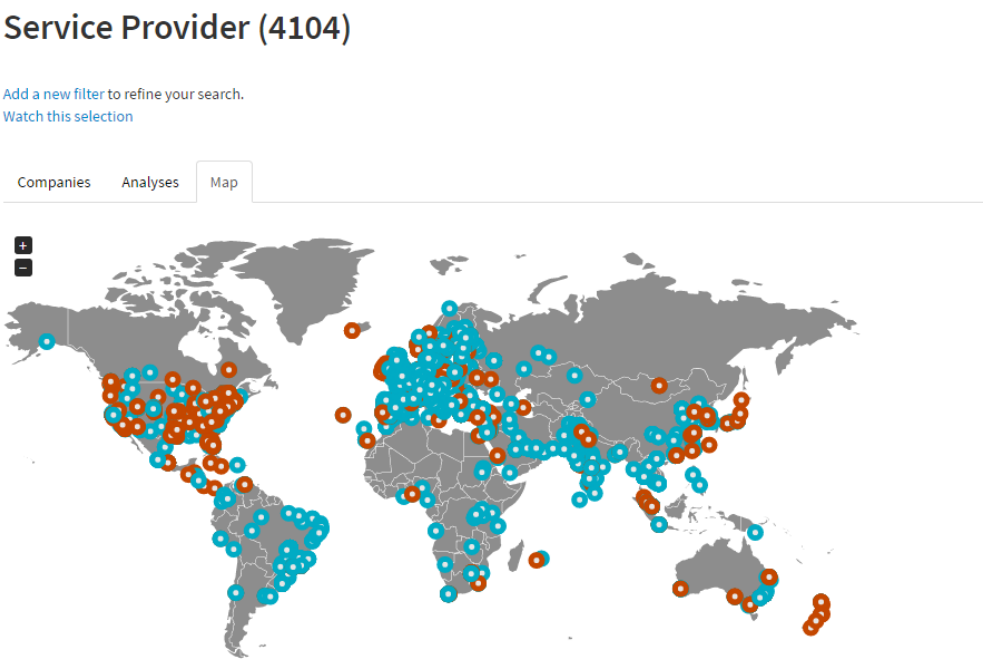

Figure 6 Screenshot of the IPIB Platform – Map of IPR Service Providers

[6] http://s.fhg.de/ipserviceprovider

The dataset was manually compiled since 2012 by extracting information on IPR service providers and their provided services via online databases of IPR service providers (IAM nominated IP experts, EIRMA registry of IP experts, ASTP-Proton database of IP experts etc.), literature review, Twitter, news announcements, online journals, case study papers, white papers, websites of the IPR service providers and by collecting information at IPR related summits. To date 2,696 companies in the IPIB provide some IPR-related legal service:

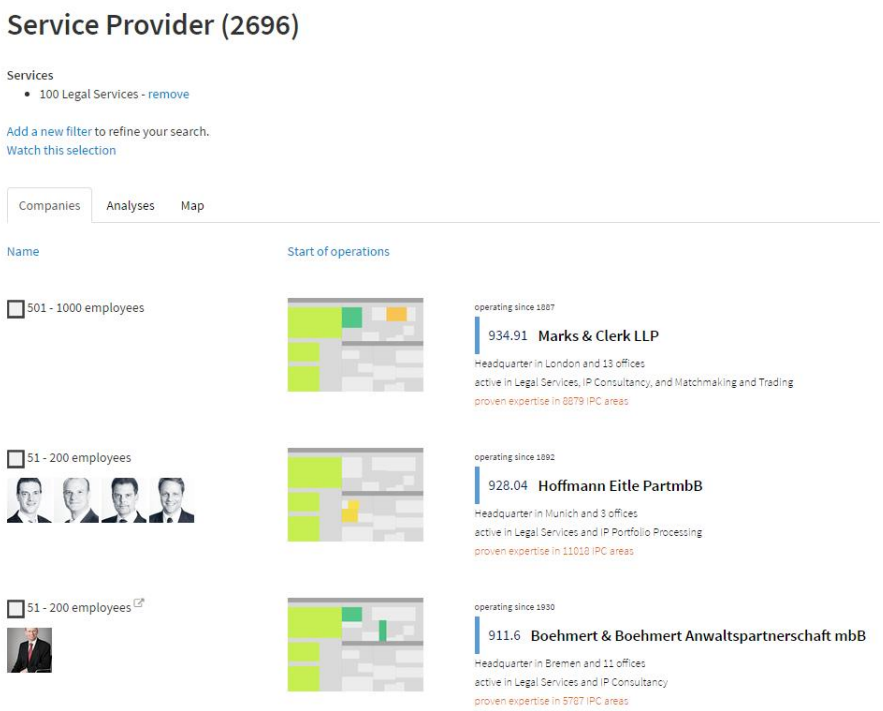

Figure 7 Screenshot of the IPIB Platform – List of Legal Service Providers

For each IPR service provider in the IPIB, a services profile is generated through manually analyzing the observable artifacts of the services provided by the companies. There are 2,696 companies assigned with one or more of the "100 Legal Service" subcategories, sub-subcategories or as a last option the main category (100). Main categories are assigned for the IPR service providers only if by studying the information collected with regards to a specific service provider, not enough information about exact services provided is available. For example: if there is only a website claiming a firm provides legal services and they give no more information or contact information the firm is assigned with "100 Legal Service" only. Currently, there are 114 such cases recorded in IPIB. An example would be "Helmut Koepsell Patentanwalt":

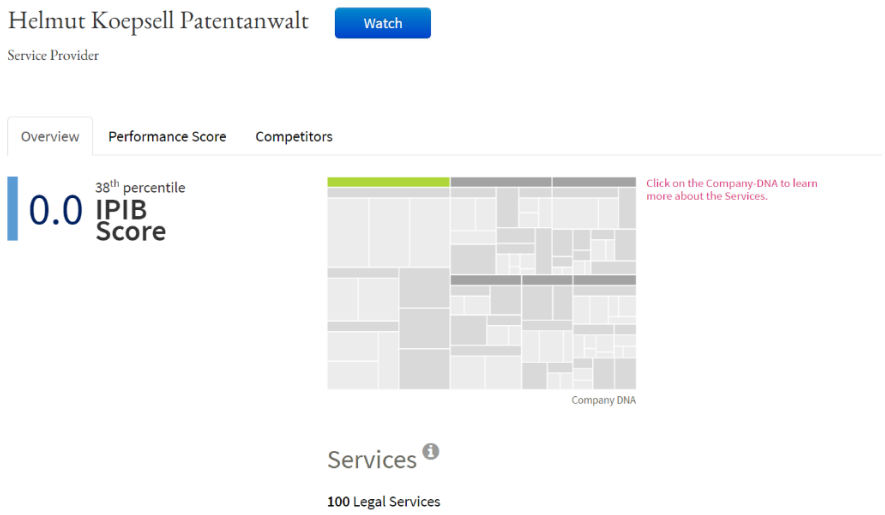

Figure 8 Screenshot of "Helmut Koepsell Patentanwalt" on the IPIB Platform

The third biggest subdomain specific dataset is the "IP Consulting" services. These are divided into fifteen various services that are assigned to 998 service providers. For three companies the main category (200) is assigned. In total 991 service providers offer consultancy services:

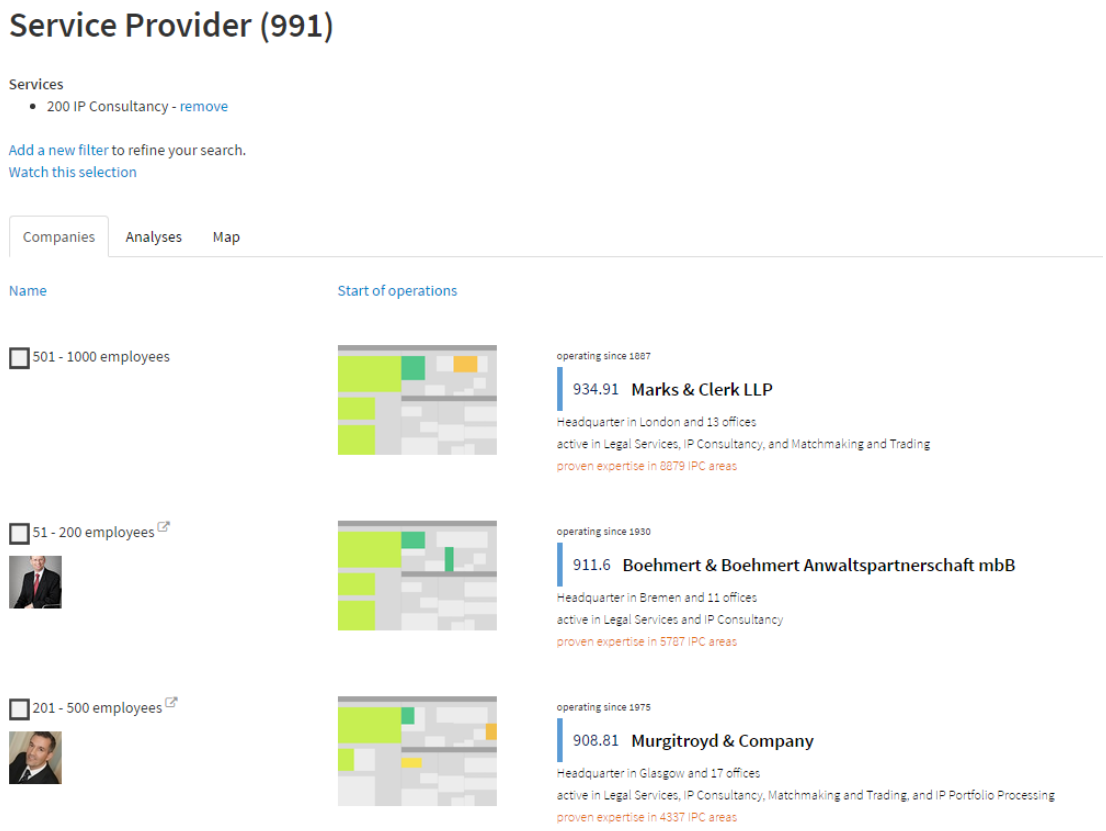

Figure 9 Screenshot of the IPIB Platform – List of IP Consultancy Service Providers

"Matchmaking and Trading" service is the second biggest subdomain specific dataset. None of the IPR service providers were assigned to the main (300) category because enough information was available in each mapping case. It was possible to assign the exact set of services by using the sub-, and sub-subcategories from the set of thirteen various services defined as "Matchmaking and Trading" service. These services are assigned to 1,222 IPR service providers:

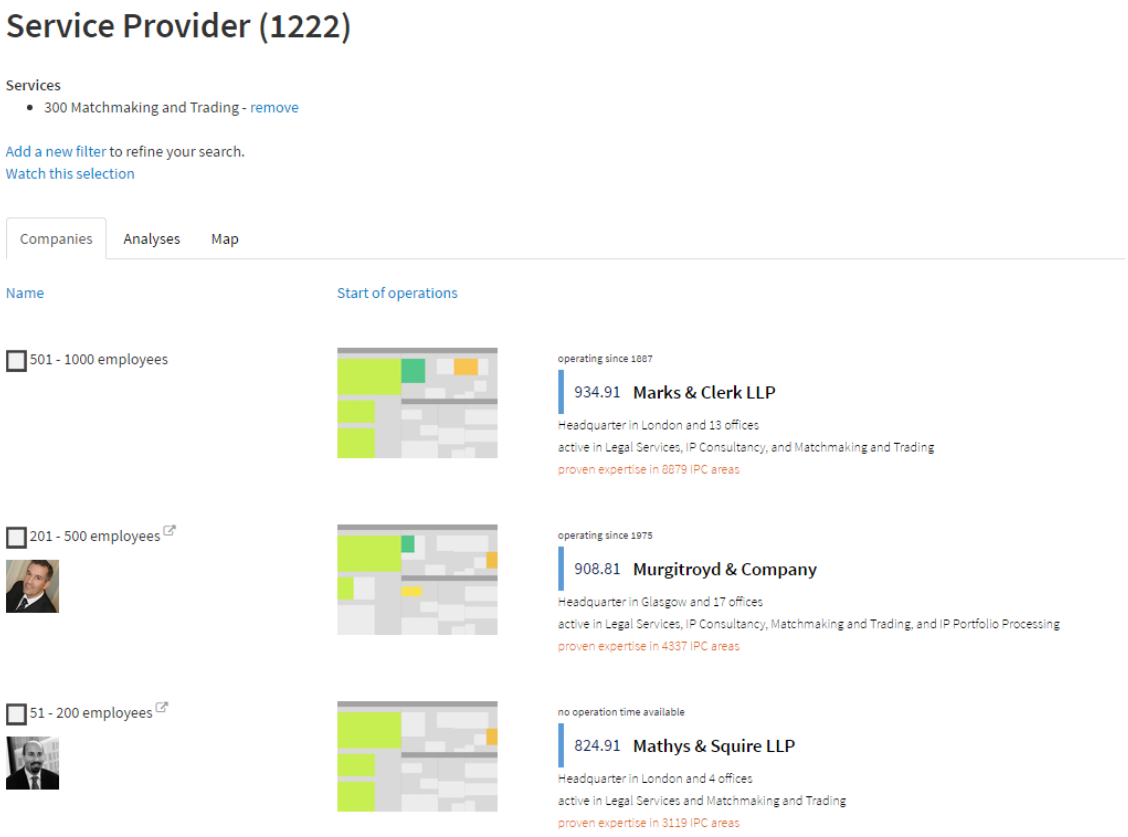

Figure 10 Screenshot of the IPIB Platform – List of Matchmaking and Trading Service Providers

The IPR Portfolio Processing services set is divided into eight various sub-services and "IPR-related Financial Service" is divided into eight various sub-services. The first is given an index of 400 and the next an index of 500. For each of these categories, one IPR services provider is assigned to the main category because of the limited information available. "IP and Portfolio Processing" service has been assigned to 1,231 IPR service providers and 173 different companies were assigned with at least one of the eight various finance related IPR services:

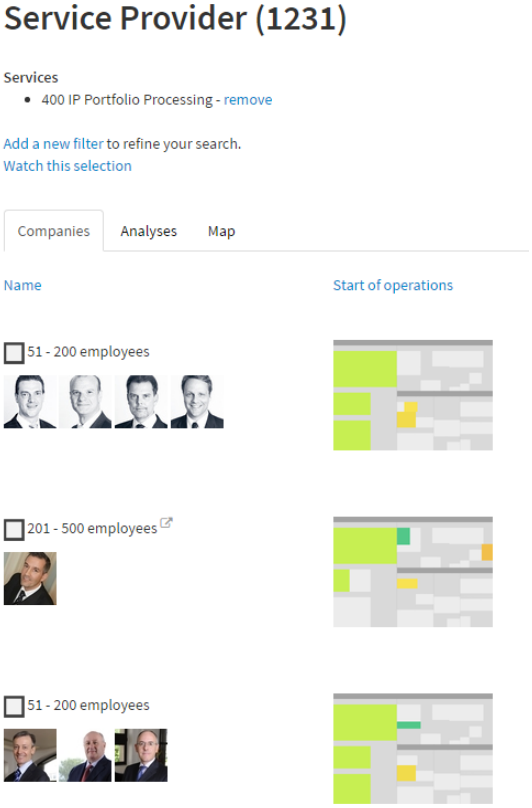

Figure 11 Screenshot of the IPIB Platform – List of IP Portfolio Processing Service Providers

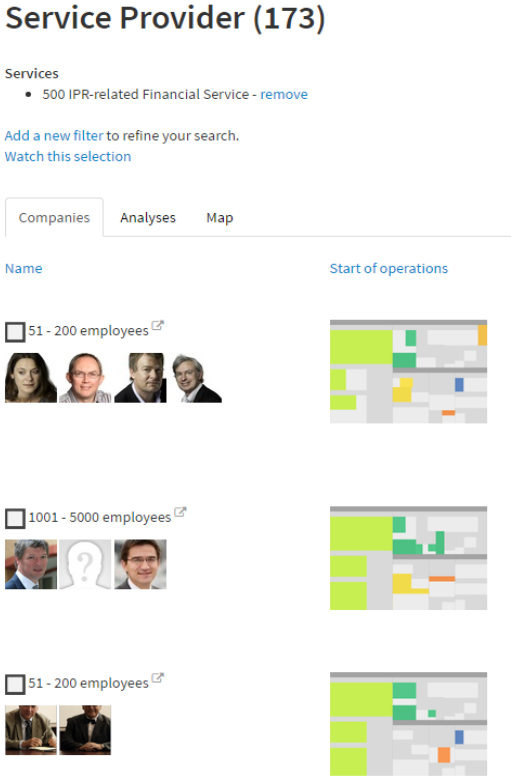

Figure 12 Screenshot of the IPIB Platform – List of IPR-related Financial Service Providers

The "IPR-related Communication Service" main category (600) is assigned to six IPR service providers in the IPIB due to not enough information available. The rest of the data collected for this category (599 entries) is divided into seventeen various sub-services. In total 605 companies are assigned to IPR-related communication services:

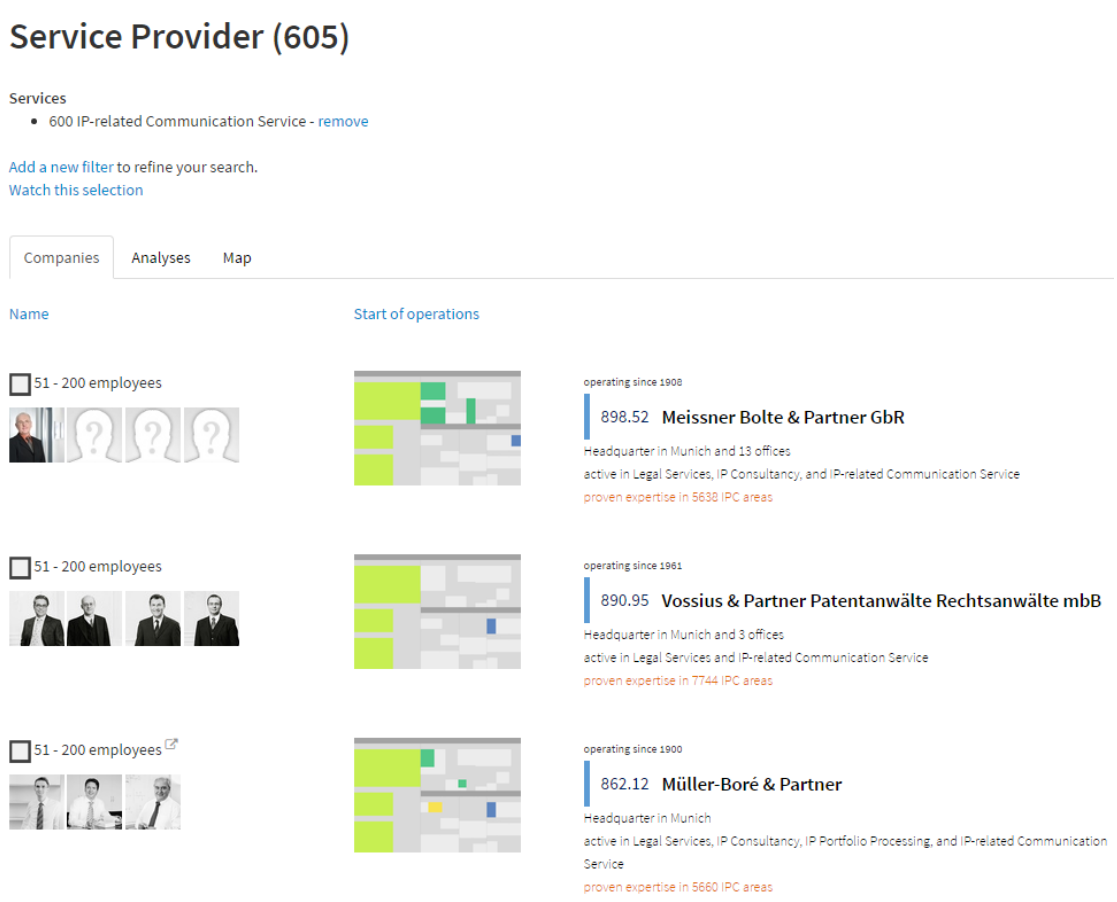

Figure 13 Screenshot of the IPIB Platform – List of IP Portfolio Processing Service Providers

The number of IPR service providers assigned for each IPR related service is presented below. The count of data entries is below the "#" column and the terms used for distinct services either under "Category", "Subcategory" or "Sub-subcategory" column.

Category	#	Subcategory	#	Sub-subcategory	#
Legal Service	114	IPR Protection	11	Patent and Trademark Search	2389
		IPR Contracting	27	Patent Drafting	2246
				Application and Renewal of IPR	2272
				Due Diligence	555
		IPR Contracting	27	IPR Transaction Support	977
		IPR Litigation	26	Non-judicial Proceeding	996
				Judicial Proceeding	934
				Arbitration and Mediation	580
		IPR-granting	24	-	-
		Standardization	1	-	-
		Anti-Trust and Competition Law Enforcement	1	-	-
IP Consultancy	3	IPR Portfolio Analysis	10	Legal Quality Assessment	453
				IPR Valuation	319
				IPR Portfolio Landscaping	263
		IP Strategy Development	424	-	-
		Commercialization Support	156	-	-
		Competitive Intelligence	4	Industry Analysis	103
				Technology Analysis	103
				Patent Analysis	147
		Prior Art Search through Crowd-Sourcing Platform	15	-	-
		Fighting Infringement, Counterfeiting and Piracy	24	Infringement Intelligence Service	134
				Technical Infringement Analysis (Software/Circuits)	36

Category	#	Subcategory	#	Sub-subcategory	#
				Infringement Search through Crowd-Sourcing Platform	2
				Collaboration with Customs	97
				Technology Development	1
		Internationalization Support	87	-	-
Matchmaking and Trading	1	Matchmaking	9	Onsite Matchmaking Service	790
				Online Matchmaking Platform	104
		IP Brokerage	144	-	-
		IPR Scouting	60	-	-
		IPR Auction	3	Onsite IPR Auction	1
				Online IPR Auction	1
		IPR Exchange	6	-	-
		IPR Sharing	112	Defensive Publishing	11
				(Online) IPR Pools for Public Use	4
		IPR Pooling / Aggregation	100	Offensive IPR Pooling	35
				Defensive IPR Pooling	13
		IPR-driven M&A Advisory	116	-	-
		Purchase and Sale of IPR	94	-	-
IP Portfolio Processing	1	Document Processing	30	Patent and Design Illustration	33
				IP Translation	104
		IP Portfolio Management	75	-	-
		IP Portfolio Administration	163	-	-

Category	#	Subcategory	#	Sub-subcategory	#
		IPR Augmentation	3	IPR Augmentation through In-House Labs	101
				IPR Augmentation through Outsourcing	34
		IPR Licensing	820	Carrot Licensing	55
				Stick Licensing	60
IPR-related Financial Service	1	Management of Investment Products based on IPR	47	-	-
		Management of Investment Products based on Royalty Liquidation/Streams	18	-	-
		Financing IPR and Innovation Processes	5	Private Financing	43
				Public Funding	76
				PPP Financing	8
		IPR Litigation Funding	13	-	-
		IPR Insurance	6	IPR Litigation Insurance for Inventors	5
				IPR Litigation Insurance for Third-Parties	6
IP-related Communication Service	6	IP-related Education and Publishing	4	IP-related Education	184
				IP-related Publication	189
				E-learning solutions for IP	29
				Organization and Execution of Meetings specialized on IP Topics	107
				IP-related Scientific Research	33
		IP Software	3	In-House IP Portfolio Management Software	73

Category	#	Subcategory	#	Sub-subcategory	#
				IPR Portfolio Management Software for Attorneys	37
				IP Valuation Software	19
				IPR Search Software	109
				Patent-based Public Stock Indexing	3
		Patent Database	6	Providing Patent Document Data	40
				Providing Data about IP Litigation	9
				Official Design, Patent and Trademark Data provided by Industrial Property and Trademark Office	19
		IP-centric HR Service	1	Matching IP Professionals and Companies through Online Platform	17
				Matching IP Professionals and Companies as HR Agency	15
		Interest Group, Political Work	45	-	-
		Association of IP Professionals	50	-	-

Table 4 Data Representation in the IPIB - Number of Entries (#) per IPR Service

Adding IPR service providers to the IPIB is an ongoing process at Fraunhofer IMW Competitive Intelligence department. The workflow structure for data collection requires that there is at least one service provider for every category listed in the IPSC. The workflow structure assures that IPSC is kept up to date because as soon as an IPR service provider appears on the Internet whose services provided cannot be categorized by the IPSC a new category is added to the IPSC. New service providers are identified

via Twitter, IPR related blogs and news announcements. Data collection framework requires that whenever a new IPR service provider is added to the IPIB, the services provided by that company should be mapped as precisely as possible. Therefore, it is a process of first assigning sub-subcategories from the IPSC. When not enough information is available the higher-level category is assigned to the service provider. When a subcategory has been assigned for a given IPR service provider, the top level category is not assigned to provide just the most precise information and not to confuse the IPIB user.

5. Applying Methontology

5.1. Knowledge Acquisition and Planning the IPSC

First the planning and knowledge acquisition phase took place from 2012 to 2014. For the knowledge acquiring process the research process was as follows:

- interviews with technology companies
- interviews with IP service providers
- several conferences and focus group meetings[7]

Each of the attended conferences or meetings on IP services topic, initial IPSC was presented either as a poster (Appendix 1 and 2) and peer-reviewed, or it was discussed in round-table discussions. Feedback was collected and directly implanted into the IP services vocabulary dataset. Domain knowledge was collected at each of the events by collecting feedback from review processes or from experts attending the meetings. Feedback was directly implemented into the IPSC after each of the events.

5.2. Specification

After acquiring knowhow the IPR services specification document was formed. In this thesis, natural language is used, and SKOS for language organization is applied. The taxonomy has an URL[8] and SKOS representation thus is computer readable. The degree of formality is semi-formal as human judgment is involved. Namely, the information originated from IPR service providers' websites, expert group statements, and forty-two interviews. The whole document is described below:

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[7] EC, JRC "Future Oriented Technological Analyses" Brussels, 27-28 November, 2014

IP Service Word in Munich, 25-26 November 2013

The European Commission Joint Research Centre, Institute for Prospective

Technological Studies (IPTS) 5th Workshop "The Output of R&D activities: Harnessing the Power of Patents" - Seville, 19-20 September 2013 and 4rd Workshop "Patent Intelligence for Policy Support" - Seville, 24-25 May 2012

EPO and OECD "Patent Statistics for Decision Makers" conference in Rio de Janeiro 11-12 October 2013

The IAM IPBC – The Annual Event for Global IP Leaders in Boston, 9-11 June 2013

OECD "Growth, Innovation and Competitiveness - Maximizing the Benefits of Knowledge-Based Capital" in Paris 13-14 February 2013

[8] https://ipib.ci.moez.fraunhofer.de/taxonomies/services

IPR services Ontology requirements specification document	
Domain	IPR Services
Purpose	Taxonomy of IPR services to be used when information is required for innovation market analyses, IP management decisions, and IP policy making.
Level of formality	Semi-formal
Scope	List of all possible IPR services offered on IPR service market. List of concepts: Legal, Consultancy, Matchmaking and Trading, Portfolio Processing, Financial and Media related IPR services.
Principal Sources of Knowledge	4,100 websites of IPR service providers, forty-two experts' interviews, topic related publications, conferences, and industry meetings.

Table 5 Ontology Requirements Specification in the IPR Services Domain

5.3. Conceptualization

In 2012 the conceptualization phase was carried out. The acquired domain knowledge was structured into a conceptual model by dividing the full set of IPR related services that are found in literature and practice into six main categories. These six main categories were further divided into subcategories and sub-subcategories. For each category, a name was chosen. The systematic architecture of IPSC was established in 2013. The order of the main categories changed according to the matching of the various services using MECE framework. According to the twenty-six interviews made in 2012 "legal Service" was often outsourced. Therefore, much of the information necessary for the subdomain conceptualization could be retrieved from the first set of interviews. It was learned that patent agents mainly provide drafting, renewals, and due diligence services among others. The full conceptual model of legal services, diving the pool of terms into eleven various sub-, and sub-sub terms were the following:

Category	Subcategory	Sub-subcategory
Legal Service	IPR Protection	Patent and Trademark Search
		Patent Drafting
		Application and Renewal of IPR
	IPR Contracting	Due Diligence
		IPR Transaction Support
	IPR Litigation	Non-judicial Proceeding
		Judicial Proceeding
		Arbitration and Mediation
	IPR-granting	-
	Standardization	-

Table 6 Illustration of Dataset of Terms for the Pool of IPR-related Legal Services

The "IP Consulting" services conceptualization was done based on same interviews. Many of the twenty-six interview partners stated that for IP strategy formation they buy in assistance like various IPR-related analysis, commercialization support or prior art searches. Once technology producers decide to expand their businesses across many countries they need to acquire internationalization support. They often outsource these services to assist them with protecting their IPR rights abroad. These types of services include infringement intelligence among other services necessary for expansion. The full conceptual model for IP Consultancy services is the following:

Category	Subcategory	Sub-subcategory
IP Consultancy	IPR Portfolio Analysis	Legal Quality Assessment
		IPR Valuation
		IPR Portfolio Landscaping
	IP Strategy Development	-
	Commercialization Support	-
	Competitive Intelligence	Industry Analysis
		Technology Analysis
		Patent Analysis
	Prior Art Search through Crowd-Sourcing Platform	-
	Fighting Infringement, Counterfeiting and Piracy	Infringement Intelligence Service
		Technical Infringement Analysis (Software/Circuits)
		Infringement Search through Crowd-Sourcing Platform
		Collaboration with Customs
		Technology Development
	Internationalization Support	-

Table 7 Illustration of Dataset of Terms for the Pool of IP Consultancy Services

The concept of matchmaking and trading was less known among our first interview partners. Therefore, this concept was extensively discussed at the IAM Boston meeting in 2013. The "IP Business Congress (IPBC) in Boston"[9] delegates included a broad range of experts from various parts of the IP marketplace, including chief IP officers and corporate heads of intellectual property; aggregators and intermediaries; members of the finance and investment communities; and lawyers and patent attorneys. Over the course of the three-day event, a range of plenary and breakout sessions on various IPR services among other topics took place. The global IP leader summit greatly helped

[9] The IAM IPBC – The Annual Event for Global IP Leaders in Boston, 9-11 June 2013

towards the conceptualization of IP trading services, where the concept of IP trading was discussed. The terms of the set of these services after analyzing all the information gathered from the event are the following:

Category	**Subcategory**	**Sub-subcategory**
Matchmaking and Trading	Matchmaking	Onsite Matchmaking Service
		Online Matchmaking Platform
	IP Brokerage	-
	IPR Scouting	-
	IPR Auction	Onsite IPR Auction
		Online IPR Auction
	IPR Exchange	-
	IPR Sharing	Defensive Publishing
		(Online) IPR Pools for Public Use
	IPR Pooling/Aggregation	Offensive IPR Pooling
		Defensive IPR Pooling
	IPR-driven M&A Advisory	-
	Purchase and Sale of IPR	-

Table 8 Illustration of Dataset of Terms for the Pool of IP Matchmaking and Trading Services

The same IAM Boston event helped to conceptualize IPR-related business models that deal with resource allocation, as many of the panel sections focused on IPR as an asset class that can be seen as a source of income. Therefore, the IPR-related financial services were conceptualized based on data collected at the event as follows:

Category	Subcategory	Sub-subcategory
IPR-related Financial Service	Management of Investment Products based on IPR	-
	Management of Investment Products based on Royalty Liquidation/Streams	-
	Financing IPR and Innovation Processes	Private Financing
		Public Funding
		PPP Financing
	IPR Litigation Funding	-
	IPR Insurance	IPR Litigation Insurance for Inventors
		IPR Litigation Insurance for Third-Parties

Table 9 Illustration of Dataset of Terms for the Pool of IPR-related Financial Services

The conceptualization of the terms for services related to portfolio management was finalized in parallel with the validation by sixteen IPR expert interviews carried out in 2013 and 2014. The interview partners were IPR service providers and therefore could provide insights to correct terminology for portfolio management related services. The conceptual model was the following:

Category	Subcategory	Sub-subcategory
IP Portfolio Processing	Document Processing	Patent and Design Illustration
		IP Translation
	IP Portfolio Management	-
	IP Portfolio Administration	-
	IPR Augmentation	IPR Augmentation through In-House Labs
		IPR Augmentation through Outsourcing
	IPR Licensing	Carrot Licensing
		Stick Licensing

Table 10 Illustration of Dataset of Terms for the Pool of IP Portfolio Processing Services

Finally, the IPR-related media services were conceptualized mainly with the help of "IP Service Word event in Munich"[10] in 2013. IP Service World can be seen as a trade fair of IPR service providers where the organizations present themselves and their services. The firms attending the summit were kind enough to sign up for interviews and to suggest concepts for the IPSC on the spot. As a result, under "IPR-related communication Service" concept, all the unions and groups of various IPR experts were assembled. The interest groups themselves argued that they mainly provide the service of IP culture building and information sharing. Secondly, it was suggested that software supports communication and decision-making while communicating results to its end-users. Therefore, software was a conceptualized into the pool of IPR-communication related services terminology set. The full set of services were conceptualized as follows:

[10] IP Service Word in Munich, 25-26 November 2013

Category	Subcategory	Sub-subcategory
IP-related Communication Service	IP-related Education and Publishing	IP-related Education
		IP-related Publication
		E-learning solutions for IP
		Organization and Execution of Meetings specialized on IP Topics
		IP-related Scientific Research
	IP Software	In-House IP Portfolio Management Software
		IPR Portfolio Management Software for Attorneys
		IP Valuation Software
		IPR Search Software
		Patent-based Public Stock Indexing
	Patent Database	Providing Patent Document Data
		Providing Data about IP Litigation
		Official Design, Patent and Trademark Data provided by Industrial Property and Trademark Office
	IP-centric HR Service	Matching IP Professionals and Companies through Online Platform
		Matching IP Professionals and Companies as HR Agency
	Interest Group, Political Work	-
	Association of IP Professionals	-

Table 11 Illustration of Dataset of Terms for the Pool of IP-related Communication Services

Like any taxonomy, the IPSC is a hierarchy of terminology in all its categories and subcategories. Formally the IPSC like any other taxonomy is an ordered directed tree with the proper terminology (Garshol et al., 2004). Therefore, conceptually the IPSC can be seen as a directed tree of six main datasets of IPR-related terminology:

– Legal Service – divided into eleven various sub-services

- IPR Consulting – divided into fifteen various sub-services
- Matchmaking and Trading – divided into thirteen various sub-services
- IPR Portfolio Processing – divided into eight various sub-services
- IPR-related Financial Service – divided into eight various sub-services
- IPR-related Communication Service – divided into seventeen various sub-services

The goal was to catalog the possible definitions and terms of the IPSC. Natural language for the IPSC was chosen from the very beginning because of the target audience. In order to make it easily understandable for a broader user base all definitions and IPR services are written in natural language and not only classification codes were used. Classification codes were created, but presented with the term and corresponding definition.

5.4. Formalization

In the formalization section, the services in IPSC are explained and defined in detail. The difference between conceptualization and formalization is that in this chapter the final analysis and edited glossary of IPR service related terms and definitions is presented. It is not only a concept of the domains but in the formalization phase, for each of the categories a definition and a category number was defined. Additionally, an SKOS representation was created. SKOS is used on its own because the IPIB platform where the IPSC is applied does not require OWL representation.

For example, the first main category is named "Legal Services" and numbered 100. It is narrowed down into six subcategories which are numbered accordingly 110, 120, 130, 140, 150 and 160, with sub-subcategories following the same logic (e.g. 111, 112, etc.). An SKOS representation created for "Legal" category is the following:

```
<skos:Concept rdf:about="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#400-legal-services">
  <dc11:title>100 Legal Services</dc11:title>
  <dc11:description>Services involving legal or law related matters like issue of patents, preparation of patent filing documents and litigation processes.</dc11:description>
  <skos:inScheme rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#"/>
</skos:Concept>
```

A part of this process was to build a complete glossary of IPR services related terms for each main category and a complete SKOS representation. The terms included concepts, instances, verbs and properties. The glossary identified and gathered all the useful and potentially usable domain knowledge and its meanings. The first conceptual prototype of the IPSC was established in 2012 based on methontology method´s first four steps (Fernandez et al., 1997). It was achieved by desktop- and state of the art research. The IPSC underwent several changes and the mid-term solutions can be found in appendixes 3 and 4. The final formalized IPSC was finished in 2015.

Firstly, definitions for IPR services is an outcome of the knowledge acquiring process from the websites of the service providers mapped in the IPIB and by studying the terminology they use to describe their services.

Secondly, the distinct set of IPR services are an outcome of the knowledge collection phase during which several conferences were attended to collect academia and industry feedback for the work.

The structure of the taxonomy is an outcome of the methontology (Fernandez et al., 1997) process. A set of seventy-two various IPR related services was distinguished on IPR service markets. This was achieved with the thesauri analysis of the set of terms. After the three interview validation steps (interviews with technology companies, interviews with IPR service providers and expert group meeting at Imperial College) seventy-two various distinguished services were identified ranging from index 100 to 660.

Adding new services based on the data pool of various terminologies for IPR services to the IPSC was finished in 2014. Three new services were suggested to "Legal" category, category 600 and 300 were rearranged by IPR expert group in London. After that, no further requests for adding categories were received.

All these steps have made it possible to move closer to describing the IPR services in a homogenous way using IPR language understood by high-level academia and industry experts and service providers themselves. In the following chapters, the common language developed since 2012 is applied to describe the complete set of services in the IPSC. The IPSC provides a comprehensive picture of the IPR service industry. The definition of an IPR service provider after establishing the IPSC can be refined to an organization which offers at least one activity from the IPSC to their customer. The IPR

service industry is the set of all IPR service providers. The IPSC is a set of all activities provided by IPR service providers for technology firms and individuals. In the next paragraphs, each distinct IPR service is elaborated on and a numerical index and definition are proposed.

100 Legal Service

European IPR remains under a threat from both developing and developed markets. Patent infringement from emerging-market competitors is a serious risk for European technology companies. Therefore, legally protecting IPR is vital for business sustainability (The Economist Intelligence Unit, 2009). If a technology company with an established patent portfolio does not have an in-house patent lawyer for IPR protection or an agent, they must outsource legal aspects of the patenting process and outsource patent protection as well. IPR legal services include a wide range of services such as preparing the application(s) and supporting documents, filing the application(s), assisting in the course of granting and review processes and representing the applicant in court or other dispute resolution bodies. Legal services are the most commonly used IPR related services according to twenty-six industry interviews conducted by end of 2012.

These kinds of services are provided by almost all large law firms like Bird and Bird LLP, Bingham McCutchen LLP and CPA Global Ltd. A short and precise definition suggested by interviews, expert group, desktop research, and literature review is the following: "*Services involving legal or law related matters like the issue of patents, preparation of patent filing documents and litigation processes".*

110 IPR Protection

Legal service providers offer their clients legal assistance in almost all aspects of protecting their clients' rights. IPR protection services are related to the process of assuring that legal rights are properly covered. The definition of 110 is *"Process of assuring legal rights to the objects of IPR (e.g. inventions, literacy and artistic works, images, logos, designs) by filing applications with Patent & Trademark Offices and Copyright Offices".*

In order to assist technology companies with IPR filings, IPR law specialist firms first conduct patent research to find out which patents are active and which innovation are

not yet protected (111 Patent and Trademark Search). These services are defined as *"Prior art search and investigation and comparison of existing intellectual property rights and applications regionally and worldwide".*

IPR protection services include also filing of additional patents or renewing current ones on patent acquisition, on divestiture, or renewal of some portions of portfolios so that their clients can enhance their patent portfolios and manage their IPR asset more tactically. Before a patent can be filed it has to be drafted (112 Patent Drafting). 112 category services are defined as *"Services related to the drafting of a description of the invention required for the patent application, i.e. the process of writing the patent description and claims".* This service is a multifaceted activity. Patent drafting refers to the process of writing the patent description and claims, which is the core of any patent application, and in due course, if allowed, of the granted patent specification.

Patent application process assistance is another service defined as *"Applications for IPR protection and renewals of IPR protection at industrial property offices (e.g. EPO, DPMA, USPTO, JPO)"* - 113 Application and Renewal of IPR.

120 IPR Contracting

IPR contracting includes legal services assisting with formal IPR related agreements between various parties. The formal definition is "*Services dealing with assisting with formal IP related agreements (license agreements, co-operation agreements, co-existence agreements etc.)*".

Services under this category include IPR related due diligence services prior to IPR transactions. Due diligence is an investigation of a patent validity or portfolio strength prior to signing a contract, or an act with a certain standard of care. 121 Due Diligence services are defined within this work as "*IPR related due diligence services prior to IPR transactions (e.g. licensing, acquisition, sale)".* Under category 120 go also all the prior deal making administration/communication actions as well as negotiations for and draft of IPR transactions (122 IPR Transaction support), defined "*Negotiations for and draft of IP transactions (e.g. licensing, acquisition, sale of IP rights), and development of legal strategies for IPR protection and use*".

130 IPR Litigation

IPR law firms work with clients against whom another patent holder has asserted its patents. These services are defined as *"A legal proceeding in a court or a judicial contest to determine and enforce IP rights".* These law related service providers support the technology companies to establish a strong defense strategy by providing a variety of services that can be divided into juridical and non-juridical law services. Non-juridical proceedings lie outside the proceedings in the court whereas juridical proceedings are associated with the protection of IPR in court. The bundle of services includes opponent party's patent portfolio legal analysis and patent infringement analysis for ongoing litigation (131 Non-judicial Proceeding) and IPR litigation support in the court (132 Judicial Proceeding).

Therefore 131 is defined as *"Legal services lying outside the proceedings in the court (e.g. determination of possible infringement cases, negotiations for extrajudicial settlements)".* And 132 *"Legal services associated with the protection of IP in the court (e.g. representation in civil and criminal proceedings of IPR owner or alleged infringer of IP rights)".*

IPR service providers assist during non-court negotiations for settlement (133 Arbitration and Mediation) or act as a mediator between the different parties. Arbitration is a nongovernmental, consent-based dispute resolution process (Smith et al., 2006). This service is defined within the IPSC as *"Legal services covering the arbitration and mediation proceedings (e.g. preparation of claims, and representation of IPR owners or alleged infringer of IP rights)".*

140 IPR- granting

Industrial Property Offices grant and renew legal rights to the objects of IPR. In Europe, the European Patent Office (EPO) provides the underlying procedures for patent grants. Together with the government, they shape the IPR legal framework for all patent-related proceedings in Europe that all the previously mentioned IPR-related service provides are under obligation for adherence. In the United States of America, the corresponding authority is USPTO and in Japan the JPO. This category includes the courts where legal disputes regarding IPR issues get resolved. The legal bodies belong in this category because with a court dispute firms IPR might be claimed as an invalid or by law

enforcement the IPR can be reassigned. 140 IPR-granting is defined as "*Intellectual property offices and courts that grant, re-arrange and renew legal rights to the objects of IP (EPO, DPMA, USPTO, JPO)".*

150 Standardization

"Legal and regulatory services related to standard-essential patents (SEP) setting" represents all service providers that have the legal right to execute IPR standards. Standard-setting organizations generally adopt policies that oversee the ownership of IPRs that apply to the standards they adopt and develop (the patent policy). The most common licensing commitment is a commitment to license on fair, reasonable and nondiscriminatory (FRAND) terms. The approach of the service providers for resolving disputes involving standards and intellectual property differs between the U.S. and Europe. Contractual arrangements on licensing (FRAND) may be interpreted differently in various areas, but both in the U.S. and EU service providers for standards formations exist – for example, the U.S. International Trade Commission.

160 Anti-trust and Competition Law Enforcement

The U.S. seeks to cover all the necessary rules on abusive behavior in the IP system whereas the European Commission and Court of Justice try to solve the issues by corrective measures written into competition law (Sanders, 2010). Therefore, there are many anti-trust and competition law authorities active in Europe, like the Competition and Markets Authority (CMA) in the UK, Bundeskartellamt in Germany. The U.S example would notably be the U.S. Federal Trade Commission. These IPR service providers provide services opposing or regulating business monopolies, such as trusts or cartels. They promote competition by offering services that seek to maintain market competition and to regulate anti-competitive conduct by companies. The definition for such services is *"Services opposing or intended to regulate technology ownership monopolies (a case where almost all IP in a certain field is owned by one company), such as trusts or cartels, especially in the interest of promoting competition. Service that seeks to maintain market competition by regulating anti-competitive conduct by companies regarding the IPR commercialization activities".*

200 IP Consulting

IP consulting firms help technology companies to manage their IPR more strategically, efficiently and successfully. They can facilitate the circulation of knowledge and technology protected by patents by providing useful information on possibilities and various options regarding IPR. Therefore, these IPR service providers contribute to innovation processes (Benassi and Minin, 2009). IP consultancy is a rather well-known IPR related service as stated by the interview partners. These services are provided for example by Allen & Overy LLP, Baker & McKenzie LLP, Bingham McCutchen LLP and Dennemayer SA. According to the interview partners most established IPR law firms offer some IP consultancy along with their law-related services. The main category is defined as *"Advisory services related to various IP aspects providing professional or expert advice in a particular area such as market specifics for a precise industry for patenting, technology and IP roadmaps, and various analyses".*

210 IP Portfolio Analysis

IP consultancy service providers usually conduct detailed patent portfolio analysis (210 IP Portfolio Analysis) in order to inform their clients about promising IPR strategy options. Category 210 is defined as *"Services for the assessment of IP rights".*

IPR portfolio analysis services include a legal evaluation (211 Legal Quality Assessment), defined as *"Services related to examination of the legal strength of IPR(s)"*. The main category includes an IPR commercial value assessment (212 IPR Valuation) defined as *"Determination or estimation the market value of patents or the underlying technology of trademarks, design rights or copyrights".* That includes a valuation of patent portfolios and technology.

The main category also includes patent portfolio development mapping which takes into account the technology field and forthcoming options for further developments which require systematic patent mapping (213 IP Portfolio Landscaping). This service is defined as *"Assessment services that comprise mapping technology fields and existing patents according to the given patent portfolio and thus estimating its market position".*

Most asset-based IP consultancy services are executed for proper portfolio analysis according to the interviews (Henry Suzuki, 2013). Nevertheless, there are IPR service

providers who offer these services separately. Patent analyses and IP portfolio landscaping allow patent owners to easily understand what might be necessary for strengthening their patent portfolios by illustrating where the client company is short on patents, where the most important patents are and what patents the client's competitors hold. The services are often provided in parallel with IP software that delivers the IP portfolio landscaping and after which strength of the portfolio is executed by consultants. IPR Portfolio Analysis is moving towards asset-based consultancy (Mikk Putk, 2013).

220 IP Strategy Development

IPR portfolio analysis is the first step for IP Strategy Development. Determining the best solutions for an IPR portfolio includes analysis of potential IPR users, potential licensees, and opportunities for acquiring key patents. IP strategy development (220) service allows technology-developing companies to assess new technology efficiently by indicating which technologies are already protected (Yanagisawa and Guellec, 2009). The service is defined as "*Consulting services for examining the best solutions of IP usage and further development. Includes strategic planning of technology trajectories/technology paths and IP portfolio development".*

230 Commercialization Support

The IPR service providers assist technology firms with converting their ideas into IPR and further into prototypes and products and eventually assist with bringing their products to the market. It is done by the implementation of best-practice techniques in the development, management, and growth of technology business. ATI Küste GmbH, AWA IPro AB, Anderson Law LLP, IP Asset Management Ltd, IPEG Consultancy B.V., Markpro (Markpro Global), Zacco and engage AG provide commercialization support for technology firms. These services are defined as "*Service that helps technology firms with converting their ideas into IPR and further into prototypes and products and bringing their products to the market by the implementation of best-practice techniques".*

240 Competitive Intelligence

Extracting insights from combined data (patent filings, IPR transactions etc.) is a valuable value proposition for IP consultancies. Data analysis is the most popular method for providing solutions for technology companies questions/issues (Mikk Putk, 2013). By using competitive intelligence (240 Competitive Intelligence), defined as *"Collection and analysis of IP related data. It is the service of defining, gathering, analyzing, and distributing intelligence about IP, IP holders, IP portfolios and any aspect of the IP environment needed to support executives and managers in making strategic IP decisions for an organization"* the IPR service providers provide valuable insights for technology firms.

IPR-related competitive intelligence service providers create an IPR-based market overview of companies (241 Industry Analysis). A service defined as: *"Services related to examining existing competitors and companies involved in IP market"*. IPR service providers additionally look more precisely into patented technologies, their technical details, and patenting requirements.

IPR service providers also investigate patent usage (242 Technology Analysis and 243 Patent Analysis). When a broader perspective is taken (242) in terms of technical specifics examination for the analysis it is defined as *"Services examining patented technologies, their technical details and – requirements for patenting purposes"*. When only patent info is the focus (243) these analytical services are defined as *"Services related to examining existing patents and drawing conclusions on patenting related information/activities".*

All the IPR related data gathered for analyses helps IP consultancies give better suggestions for their clients in terms of IPR developments. Beacon IP LLC, ATeNe GmbH, IDU Consult, IP Checkups Inc, IP Navigation Group LLC, Intelleigen Legal LLC, Intepat IP Services Pte Ltd, ip Value Added Ltd or RP Partners Ltd. offer competitive intelligence solutions for technology companies.

250 Prior Art Search through Crowd-Sourcing Platform

IPR service market is lacking behind other service industries and thus the emergence of crowdsourcing platforms for IPR is a recent trend whereas it was evident in other sectors

already several years ago (Mikk Putk, 2013). Companies that are looking for solutions post their challenges on the firm's website or special crowdsourcing platforms to find answers or feedback from a wider audience, the user base of that crowdsourcing platform. Individuals and firms then try to find IPR solutions for the posed tasks. Platforms searching for active IPR (250 Prior Art Search through Crowd-Sourcing Platform) help technology companies to decide whether to file a new patent or to look for licensing partners and are therefore practical (Dr. Eng. Michele Pennese, 2012). Similarly, to open innovation platforms, IPR related crowdsourcing platforms like AskPatents.com, Technik2day.net or Innovationskraftwerk.de provide accessible and affordable intellectual property search services to look for existing active patents. Some more examples of companies that provide crowdsourcing option would be InnoCentive Inc, EFF Patent Busting Project, CrowdIPR, Peer to Patent and Patexia Inc. The service these companies provide is defined as *"Service that allows an organization or an individual to collaborate with a community to find out if a specific technology exists/is patented".*

260 Fighting Infringement, Counterfeiting and Piracy

In order to fight piracy (260 Fighting Infringement, Counterfeiting and Piracy), it is necessary to search and block infringed products. That activity is defined as *"Services specialized on detecting and interfering IPR infringements".*

In some of the violation cases, IPR consultancies are required to work with IPR lawyers if they wish to fight infringement cases. First, the conflicts with regards to IPRs must be discovered and violations must be proven. Firms might subcontract some of the services to other IPR service providers for searching and demonstrating IPR infringements (261 Infringement Intelligence Service). *"Services for searching and demonstrating IPR infringements"* is the definition in the taxonomy for this kind of service.

When it is necessary to apply reverse engineering for the technical detection of infringements (262 Technical Infringement Analysis (Software/Circuits)) it is carried out by a technology specialist. That activity is defined as a *"Service that includes the technical detection of infringements (e.g. through reverse engineering)".*

The Internet enables sharing collective knowledge effectively in order to detect infringement, counterfeiting and piracy. Intellectual property-related crowdsourcing

platforms are online professional networks of technology and intellectual property specialists. Ideas or problems are made available through crowdsourcing to anyone that cares to discover them (263 Infringement Search through Crowd-Sourcing Platform). These open platforms enable the sharing of collective knowledge (Watson, 2008; Chesbrough, 2006) and are defined within this work as a *"Service that allows an organization or an individual to collaborate with a community to find out if an organization or inventor has been involved in litigations or not".*

For fighting counterfeiting and piracy, it is necessary to collaborate with customs (264 Collaboration with Customs) if the infringing is taking place in another regulation space/region. These services are defined as *"Assistance in searching and actively blocking infringed products through cooperation with customs".*

Most of the big law firms are engaged in fighting infringement like Allen & Overy LLP and Baker & McKenzie LLP as well as smaller and specialized IPR service providers like Acapo AS, Acumen Legal Services (India) Pvt Ltd, and UBM TechInsights. Some of the most specialized ones advise technology companies on avoiding counterfeit. These niche services are under category 265 Technology development, defined as *"Services that support building technological solutions or technology developments that make it difficult to counterfeit".*

270 Internationalization Support

IP consultancy in terms of internationalization support (280 Internationalization Support) is important for practicing companies, since entering new technology markets or expanding existing product lines across international borders requires a careful review of the global patent landscape. When expanding, local patent laws, local technologies and clusters, societal and environmental aspects need to be taken into consideration. Once again most of the big law firms practice internationalization support related services (Boehmert & Boehmert, Bird & Bird LLP, Baker & McKenzie LLP etc). More specialized service providers in the field would include ATI Westmecklenburg GmbH, Coller IP Management Ltd, Wurzer & Kollegen GmbH, alpha & omega Law Corporation and Sagacious Research Pvt Ltd. This set of companies is defined as *"Services for supporting internationalization and trade of IP. Includes assistance in finding investors and business partners abroad and also offering any IPR related advice in legal, strategic*

or politic topics for certain countries (e.g. local patent laws, local technologies and clusters, societal and environmental issues)".

300 Matchmaking and Trading

IPR service providers can operate as facilitators between parties interested in each other's technologies. They can take various forms, from intellectual property rights brokerage to online free intellectual property rights sharing platforms, while each of these activities counts as a new service in the taxonomy. These kinds of matchmaking service provider firms enable the circulation of knowledge and technologies and therefore benefit innovation sharing and developments (Hall and Helmers, 2010). Most companies are interested in increasing the connections from outside organizations and in facilitating various forms of intellectual property rights sharing or exchanges (Lo et al., 2010). The services provided by matchmaking and trading firms are defined as *"Services related to the arrangement of IPR related development needs of companies with available resources. Includes trading of IPR that results in an exchange of ownership".*

310 Matchmaking

Companies have started to consider acquiring useful external knowledge and technologies more actively, besides producing their own. In parallel, they are attempting to generate revenue from letting others use internal knowledge and technologies that they do not use. Many companies, however, are struggling with identifying who has available innovative technologies or who is the prospective buyer of the internal technologies that they wish to share. One of the traditional ways of finding partners for the IPR sharing needs is turning to technology matchmakers, e.g. technology transfer offices, associations of intellectual property rights related companies and professionals. All of the above mentioned provide *"Service of linking IPR (development) needs with available resources (including researchers)".*

Much of matchmaking can take place in networking events organized for specific technology/industry fields dedicated to face-to-face information/knowhow and IP exchange (311 Onsite Matchmaking Service). These events or fairs are specially designed by firms for networking purposes for interested parties offering *"Services related to*

organizing face-to-face matchmaking events. Including conferences or forums created for purpose of connecting IPR (development) needs with available resources".

Online platforms for matching the intellectual property rights needs of corporations have become more popular in the current decade. During summits, a limited number of individuals/corporations gather with similar technology or intellectual property rights interests, but the Internet offers limitless access. The Internet-based service is defined as *"Web-based platforms for services connecting IPR (development) needs with available resources"*. There are many examples of online matchmaking services. In Germany, INSTI, which comprises thirty-nine private and public regional institutions, runs the Internet-based service called Innovation Market in order to link buyers and sellers of technology (OECD, 2006a). The German Patent and Trade Mark Office provides information on licensable patents through its online database. The Intellectual Property Office in the United Kingdom also provides an online database that contains information about licensable patents. The European Commission established a network of Innovation Relay Centers in 1995 whose services include helping to match buyers and sellers of technology, as well as through the Internet-based system in collaboration with the CORDIS Technology Market Place, and provision of advice on innovation, intellectual property, licensing and negotiation (OECD, 2006a; OECD, 2006b). Private companies such as InnoCentive, Yet2, Tynax, UTEK, NineSigma, YourEncore, Innovation Exchange, Activelinks, and SparkIP offer or have offered web-based matchmaking platforms that connect intellectual property rights owners wishing to sell their intellectual property and intellectual property consumers seeking valuable ideas and technologies (Yanagisawa, Guellec 2009). ATI Westmecklenburg GmbH, AVENIUM Consulting, Florenus AG, GENIUS Venture Capital GmbH, GEWI GmbH & Co. KG, ipal Berlin GmbH and Rubitec GmbH are the company examples that all belong to 312 Online Matchmaking Platforms category.

320 IPR Brokerage

Brokerage services are well known in the traditional financial markets. Similar services are also provided within IP markets. These services are defined as *"Services related to assisting patent owners in finding licensees, buyers for their IPR. Service includes negotiating IRP-related contracts, IPR purchases, - or sales in return for a fee or*

commission". IPR brokerage activity helps reduce search and transaction costs by investing in specific knowledge and connections on both sides of the market. There exists a large number of patent brokers, most of which tend to be small companies with fewer than 10 employees. ThinkFire Services USA Ltd. is a good example. They have provided IPR brokerage services to over 80 global technology companies and investment firms, including Ciena, Hewlett-Packard, Kodak, NEC, Nokia, and Silver Lake Partners (Millien and Laurie, 2008). Many other IPR-centric firms, such as Benoît & Côté Associés Inc, IPotential, Inflexion Point, Charles River Associates, Coller IP Management Ltd, Pluritas, ESA Erfinderzentrum Sachsen-Anhalt GmbH, ipCapital Licensing Company LLC and Global Technology Transfer Group, are offering IPR brokerage services as well. Patent brokers help patent owners buy, sell or license their technologies. IPR brokerage service is provided in exchange for a fee contingent on successful transfer. IPR brokers in most cases do not facilitate just the sale or licensing of patents, but rather the technology transfers in general. That means that the above-mentioned service providers facilitate patents and related know-how, and they offer consulting services helping patent owners commercialize and sell their IP assets. Such brokers have existed for a long time. Lamoureaux and Sokoloff (2002) have documented the positive effect of brokers on the U.S. market for patented technology between 1870-1920. These brokers were typically patent agents or lawyers who matched inventors looking to sell new technologies to investors or buyers eager to commercialize them.

330 IPR Scouting

It is often necessary to use the services of IPR scouts when it is not clear from whom the IP should be licensed or bought. IPR scouts are specialist firms or individuals who seek for the missing patent or patents for the technology companies or patent pools. ATeNe GmbH, Bramson & Pressman, CPA Global Ltd., GTT Group Inc., Hamburg Innovation GmbH, Patent Calls Inc. and Transpacific IP Management Group Pte Ltd. offer IPR scouting as part of their services. This service is defined as *"Specific services that help you to find necessary IPR. It is a team of IPR and technology experts or an expert who observes and recommends promising IPR for acquiring"*.

340 IPR Auction

Web-based IPR auctions providers provide platforms for online auctions that allow willing patent sellers to list their innovative ideas protected by patents which are available for sale or license and allow willing buyers to check if valuable patents are marketed. These services are defined as 342 Online IPR Auction. Live IPR auctions are categorized under 341 Onsite IR Auction. ICAP Patent Brokerage LLC, Inflexion Point Strategy LLC, Ocean Tomo LLC and Shenzhen United Property and Share Rights Exchange (UPEX) are the company examples who provide *"A service dedicated to organizing a public sale in which intellectual property or IPR portfolios are sold to the highest bidder".*

350 IPR Exchange

Included in the set of all IPR services are private firms that seek to establish online exchange platforms. On those platforms, patents and ideas can be listed and traded. These services are defined as *"Traded exchanges like IPXI (whether physical or online locations) similar to the NYSE and NASDAQ where yet-to-be-created IPR-based financial instruments would be listed and traded much like stocks are today".* China Technology Exchange (CTEX), where bid and ask prices for IPR are listed for public trading, and Shenzhen United Property and Share Rights Exchange (UPEX) are the initiatives from Asia. Western examples include Ocean Tomo LLC and Tynax Inc. Online patent marketplaces appeared as early as 1998. But replicating what eBay has done for collectibles in the market for patents has proven difficult. Some of the online portals dedicated to facilitating patent exchanges have been shut down or renamed and redirected towards other services[11] (Hagiu and Yoffie, 2013).

360 IPR Sharing

Not all technology owners want to simply buy or sell their IPR. The patent system has been stated to harm to innovation in several cases (Bessen and Meurer, 2009) and

[11] For instance, Patent License and Exchange (pl-x) was created in 1998 as an online IPR and licensing marketplace. By 2006 it had been renamed PLX Systems and completely dropped the marketplace idea; instead, it provided software solutions for business and financial management of IP for the music and entertainment industry. Other online platforms for matching patent sellers or licensors with buyers or licensees that have disappeared include Open-IP.org, TechEx, PricewaterhouseCoopers' IPEX, Ocean Tomo's "The Dean List".

therefore some inventors wish to make their inventions public and thus free. These services where inventors make their inventions public and thus free is defined as *"Services dedicated to various forms of IPR sharing"*. Most known are defensive publishing sites under this category for which a category 361 Defensive Publishing is created. These services are defined as *"Defensive publishing or platforms where inventions are made public. Disclosing an enabling description and/or drawing of the product, apparatus or method so that it enters the public domain"*. Examples would be Prior Art Publishing GmbH, Research Disclosure, The IP Collective, P&TS AG and Patent Services India.

There are initiatives besides defensive publishing, like GreenXchange, that intend to facilitate sharing and accessing of patents covering specific technologies by collecting patents and allowing anyone to use them free of charge. These are emerging in some technology fields. The Eco-Patent Commons in the clean technologies field is another example. A similar example is the Patent Commons Project for open source software that provides online databases containing information on patents that companies agreed not to assert against the open source community under certain terms and conditions so that developers and users of open source software can utilize existing software without worrying about patent infringement issues (Van Hoorebeek and Onzivu, 2010). These services are bundled under 362 (Online) IPR Pools for Public Use and defined as *"Platforms for sharing IPR for free"*.

370 IPR Pooling/Aggregation

In general, an intellectual property rights pool is an agreement between two or more patent owners to license one or more of their patents, which are generally essential for a certain technology, to one another or to a third party (Clark et al., 2000). An intellectual property rights pool is an arrangement in which intellectual property rights holders bundle distinct patents and then collectively license them. The first such combination in the United States was the formation of a patent pool covering intellectual property rights related to sewing machines in 1856 (Jeitschko and Zhang, 2012). Intellectual property rights portfolios consist of many patents and other forms of registered intellectual property rights. Some intellectual property rights in the IP pools are more important than others. Usually, patents have the most value compared to other registered rights in the pools. The conventional knowledge is that the

development of intellectual property rights pools is welfare-enhancing when the intellectual property rights in that IP pool are complementary. This is because the IP pool can avoid the double-marginalization problem often linked to independent licensing (Gallini, 2011; Brenner, 2009). Companies can develop the patents themselves or acquire the intellectual property rights of others. It is important to stress that not only technology companies build patent portfolios. Some entities are dedicated to developing strong patent portfolios by bundling complementary pieces of patents. All these pooling service providers are categorized under 370 IPR Pooling/Aggregation. The difference from pure scouting service is that the IPR that is found is not usually sold, but the found IPR is more likely to be licensed to third parties. These IPR aggregation service providers are referred to as patent pools. Patent pools are formal or informal organizations in which come together in order to license patents to each other or to third-parties (Lerner et al., 2007; Shapiro, 2001). Pooling is usually done for generating income from licensing. There are few examples of non-profit pooling cases like the „Golden Rice, Open Innovation, and Sustainable Global Food Security" case, where many patents from different owners were pooled together to develop a new sort of rice. This case is a perfect example of offensive pooling activity (371) defined as *"The service of pooling of patents in order to create innovations and protect them. It includes asserting the rights against companies that would use the inventions protected by such patents (operating companies) and granting licenses to these operating companies in return for licensing fees or royalties".* Offensive patent pooling is something that IPCom GmbH & Co. KG and PAPST LICENSING GmbH & Co. KG claim to practice.

Defensive intellectual property rights pools generally do not use their patents to provide any products or services. Instead, they attempt to establish licensing programs based on their patent portfolios, and generate revenue from such licensing activities. Such aggregation services are defined as *"The service of purchasing of patents or patent rights to keep such patents out of the hands of entities that would assert them against operating companies"*. Some of the representatives of this category launch co-operative ventures that purchase and license intellectual property rights to its members for defensive purposes (372 Defensive IPR Pooling) (Gray, 2008; JPO 2008a). Intellectual Ventures, RPX Corporation, Schox PLC Patent Group, PROvendis GmbH, OTB IP Management B.V. and Gleiss Lutz have been stated in media resources to practice defensive intellectual property rights pooling, which results in stick licensing (discussed

later – 462 Stick Licensing), causes patent thickets[12] that harm the process of innovation. Large operating companies (e.g. Barnes & Noble, Best Buy, Cisco, eBay, HTC, IBM, Intel, McAfee, Microsoft, NEC, Nokia, Panasonic, Research In Motion, Samsung, Sony, Verizon) pay RPX annual subscription fees ranging from tens of thousands of euros to millions of euros, depending on operating income (Raymond Millien, 2013). In exchange, RPX identifies patents that might be threatening to subscribers, acquires them (or the right to grant sublicenses) in the open market and provides all of its subscribers with licenses to those patents. The patents owned by RPX are also made available for use in counter-lawsuits against non-members who initiate litigation against members. An intriguing feature of defensive aggregators is that they make public commitments never to litigate in order to extract revenues. This commitment helps differentiate them from patent trolls[13] and serves to re-assure potential subscribers, but at the same time, it creates a significant free-rider problem. When RPX buys intellectual property rights (e.g., for Nokia in smartphones), and eliminates the threat from a troll, non-subscribers in the same industries (e.g., Motorola) equally benefit, so they may be less likely to pay RPX's subscription fees (Hagiu and Yoffie, 2013). Service providers referred to as "patent trolls" are a phenomenon that has been widely discussed in the literature (Shapiro, 2001; Seyfer, 2007; Barron, 2008; Hansell, 2009). For political correctness reasons term is avoided in the taxonomy. Nevertheless, pooling is split into defensive and offensive pooling which is a good indicator of the nature of such activity.

380 IPR-driven Merger and Acquisition Advisory

Mergers and acquisitions (M&A) between technology companies might happen due to various reasons besides purely monetary initiatives. Nowadays M&A can take place solely because the target company holds valuable IP rights for the acquiring company. When a potential competitor holds valuable or even conflicting IPR, the IPR may become the driving component of the transaction. Whether assisting on sell-side or buy-side, these IPR service providers focus on the IPR within contemplated corporate transactions. Service providers have emerged in this area in order to guide technology companies in

[12] A patent thicket is "a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology" (Shapiro, 2001).

[13] Patent troll is a pejorative term used for a person or company who enforces patents against one or more alleged infringers in a manner considered aggressive or opportunistic with no intention to manufacture or market the patented invention (Poltorak, 2006)

their M&A activities. These services are categorized under 380 IPR-driven Merger and Acquisition Advisory. They earn fees based on the value of the entire deal or according to the value of the IPR within the deal. Services provided by such entities may also include legal services discussed above, like IPR due diligence, consultation on the integration of IPR and operations as a result of M&A activity. Other services may include IPR deal structuring, as well as general consultations related to contemplated investments, mergers, acquisitions, divestitures, joint ventures and other corporate transactions (Millien and Laurie, 2008). IPR service providers like 3LP Advisors LLC, KNPZ Rechtsanwälte, MI.TO. Technology SrL, Mathys & Squire LLP and McKenna Long & Aldridge LLP provide IPR driven M&A advisory. The service is defined as *"Services similar to traditional investment banking services where a percentage fee is received from IPR motivated M&A activities. Services advising technology companies in their merger and acquisition (M&A) activities based on the companies IPR portfolio and earning fees based on the value of the entire deal (or apportioned according to the value of the IPR within the deal)".*

390 Purchase and Sale of IPR

Purchase and sale of intellectual property rights are the most robust mean of commercializing one's intellectual assets. These activities are defined as *"Services that provide assistance with actions that involve the exchange of IPR ownership".* However, not all companies have the resources, capital, and know-how to do it in a way that is strategically reasonable. This is where the professional traders of intellectual property rights come in – these service providers buy intellectual property rights for using it for production or for later resale (390 Purchase and Sale of IPR).

400 IP Portfolio Processing

A patent portfolio's value can be a significant part of a corporation's overall value. IP has been even stated to be up to 80% of corporations' value (Raymond Millien, 2013). Knowing this, companies must give the same measure of attention to IPR portfolio managing as they do to their other investment portfolios. The set of services is defined as following: *"Various services related to the creation of IPR portfolios and partial management processes of the portfolio related to creating revenues out of IPR".*

410 Document Processing

The 410 subset of services is defined as *"Services related to assisting with the documentation of patent, designs and trademark process / application itself"*. An IPR service specialist providing this service can assist their clients with portfolio processing decisions starting from the basics like creating visuals and managing the documentation of the patent process. All related visualization services are categorized as 411 Patent and Design Illustration with a corresponding definition of *"Services creating visuals to meet the requirements for filing patent, designs and trademark applications"*.

International technology companies need to patent in various countries and therefore might need assistance with language competences. This sub-subset is categorized in the taxonomy as 412 IPR Translation and defined as *"Services related to assistance of translations of IP documentation".* Most law companies have competence in this area (AAA Legal Services, Clairvolex Knowledge Processes Pvt Ltd, Covington Burling LLP), but this work can be done by a patent agent which does not necessarily require that the person needs to have law degree, therefore there are other specialized IPR service providers in this area like Bache Technical, IP Services GmbH, Limbach Lines, PLuTO and Inovia Holdings Pty Ltd who have the opportunity to subcontract all of the document processing services that require legal experience.

420 IP Portfolio Management

IP portfolio management consists of updating the valuable patents, collecting royalties and negotiating the terms and conditions of the license agreement with potential licensees. IP portfolio management services assist with IPR pool organization especially with regards to under-utilized parts of the patent portfolios. If IPR service providers find that client's patent portfolios have some value, and identify potential licensees, then an IPR specialist firm can help the client with the portfolio management proceedings to gain revenue from its patent assets. All these activities add to the 420 IP Portfolio Management category defined as *"Services related to outsourcing all IP portfolio management related decision like updating the valuable patents, collecting royalties and negotiating the terms and conditions of the license agreement with potential licensees".* AVENIUM Consulting, ATHENA Technologie Beratung GmbH, BGW AG, Bird & Bird LLP, CAPITAL4IP SA and Chawton Innovation Services Limited offer IP portfolio management

as part of their services. This service is often completed by law firms since IP portfolio management includes several legal services.

430 IP Portfolio Administration

Administrative activities regarding the IPR portfolio are strictly limited to maintaining the existing IPR portfolio. Portfolio Administration service does not include for example services that would take care of buying new IPR or getting rid of some unused IPR. Under category 430 are services that deal mainly with updating the existing IPR in the portfolio, so only the existing property is administered. Therefore, the corresponding definition is *"Maintenance and renewal of the IPR portfolios as well as collecting royalty rates and dealing with licensing".*

440 IPR Augmentation

IPR Augmentation is the creation of IPR for a client or research partner. Often institutions that are responsible for contract research will do intellectual property rights augmentation through choosing the right research partners. Firms can outsource some of the IPR creation or can choose to develop it in-house. The corresponding category 440 is defined as *"IPR creation, either for creating new technologies through cooperation with other institutions and as a result being the owner (or co-owner) of the patents created out of that process; or developing new technologies and getting patents on them in-house, using internal R&D resources"*.

Some technology firms build their intellectual property rights portfolios based on the intellectual property rights generated through their own internal R&D activities (441 IPR Augmentation through In-house Labs). Tessera Technologies Inc., Rambus Inc. and venyard GmbH practice in-house intellectual property rights augmentation. Others create intellectual property rights portfolios through strategic collaborations or acquisition of other parties' patents or knowhow (442 IP Augmentation through Outsourcing). These would include ATI GmbH Anhalt, Bayern Innovativ GmbH, GWT-TUD GmbH, Hamburg Innovation Gmbh, IMG Innovations-Management GmbH, Technologiebroker Bremen GmbH and Transpacific IP Management Group Pte Ltd. In the first case the definition is *"Developing IPR for augmentation purposes within the institution in order to develop technologies or IPR portfolios"* and the second case the

definition is *"Services related to IPR creation for augmentation purposes for various organizations by third parties"*.

450 Licensing IPR

Licensing patented technology can be a significant revenue stream for many technology-developing companies, not only for the intellectual property rights pools (Monk, 2009). Many technology companies, however, do not have enough human resources, capital, and know-how to formulate and facilitate proper patent licensing programs (Tonisson et al., 2016). Specialized IPR service providers help these technology companies by providing support services for licensing. These services are defined as *"An act of authorization by the licensor to use the technology by the licensee. Services of licensing and advising for licensing, done by service providers e.g. licensing agents"*. Licensing specialist firms would include BGW AG, AccordiaIP, Bayerische Patentallianz GmbH, General Patent Corp, ICAP Patent Brokerage LLC, ICEBERG Innovation Capital Ltd and IMG Innovations-Management GmbH among many others. Technology transfer offices are responsible for the licensing of some University's owned patents, but there are also some technology companies like InterDigital Inc. or WiLan Inc that produce intellectual property rights and technologies mostly for licensing them out.

In cases where IPR service providers assist with out-licensing, they mainly attempt to assist clients in finding potential licensees and closing license agreements with those parties. In this process, two tactics are known: The first is when transaction parties enter into licensing contract entirely voluntarily (451 Carrot Licensing), or in the second case (452 Stick Licensing), one party is forced to pay the royalties by being accused of infringing. The combination of both is a rather unlikely tactic (Bramson, 2000). The definition for the first service is *"Services executing carrot licensing involve bringing together licensing partners voluntarily. A carrot patent licensing approach is appropriate when the prospective licensee is not practicing the patented invention and is under no compulsion to take a license"* and for the second tactic, 352 Stick Licensing, *"Services pursuing stick licensing involve to some degree infringement. A stick patent licensing approach is applied when the prospective licensee is already using an active patent technology and, thereby, infringing that technology right"*.

500 IPR-related Financial Service

Some of the most significant recent changes in the markets for intellectual property rights have occurred through the emergence of new players whose business models are focused on extracting value from intellectual property rights (Lipfert and Ostler, 2009). Namely by the emergence of companies that provide IP-based financial instruments such as IPR-based collateral, IPR-based investment, and IPR securitization. By assessing the value and risk of a counterparty's IPR carefully, these companies provide capital to their counterparty against its IP (Yanagisawa and Guellec, 2009). All such service providers are categorized under "500 IPR-related Financial Service"

Licensing practices which can shift companies' intellectual property rights management from a defensive strategy to a more aggressive strategy have emerged in the beginning of the new millennium. These are usually non-practicing entities like Intellectual Ventures who function like IPR private equity funds. These intellectual property rights firms concentrate on extracting money from offensive licensing strategies and have changed the innovation landscape (Ewing and Feldman, 2012). Intellectual property rights finance specialist firms may help technology companies or inventors holding valuable intellectual property rights that will generate revenue but will not match companies´ near-term financial demands by providing intellectual property rights based financing solutions. Intellectual property rights owners can get an upfront payment in exchange for selling all or a portion of their intellectual property rights, such as patents and future royalties, to such intellectual property rights specialist firms. This is the case with the Intellectual Ventures business model, where inventors are paid an upfront fee, and in the case of successful licensing, they are expected to receive a percentage on the licensing revenues/profits made later by the intellectual property rights investment product. The main category is defined as *"Resource allocation as well as resource management, acquisition and investment. In other words, finance deals with matters related to money and the markets"*.

510 Management of Investment Products based on IPR

Firms who focus on providing intellectual property rights related investment services seek to monetize patents by creating investment products based on intellectual property rights. They create strategic intellectual property rights portfolios by investing money

raised from the capital markets in promising inventions to later sell, litigate or license the patents out. These intellectual property rights related financial service providers look to place investors' money into inventions related to future-oriented developing technologies. Intellectual property rights investment funds can use both the defensive and offensive strategies of pooling business model that was elaborated on in the last chapter. Innovation Network Corporation of Japan and Intellectual Ventures are examples of companies that employ this business model. (Clark et al., 2000; INCJ, 2009). IPR finance entities acquire capital from capital markets to buy a number of valuable patents to create their intellectual property rights portfolios and later license them out or litigate against technology companies (Millien and Laurie, 2007; 2008). Altitude Capital Partners, Rembrandt IP Management, Schox PLC Patent Group and Acacia Technologies are examples of such firms. Those entities can provide information, access, and even financing to enable intellectual property rights transactions. These services are defined as *"Services similar to traditional venture capital (VC) or private equity firm services, but specializing in spinning out promising non-core IP which has become "stranded" within larger technology companies, or creating joint ventures between large technology companies to commercialize the technology and monetize the associated IP. IP private equity and venture capital firms raise funds from institutional investors such as companies, banks, governments or high net worth individuals, as well as private equity fund managers themselves".* According to literature intellectual property rights finance service providers could significantly influence the circulation of patents (Yanagisawa and Guellec, 2009).

One of the downsides of these models is the issue with the so-called patent trolls and patent thickets already discussed in IP pooling section. The model could be defined as the aggregation of intellectual property rights which are licensed voluntarily or by going to court by patent owners to licensees through some medium. The medium can be a joint venture set up specially to administer the patent pool, as discussed in the IPR Portfolio processing chapter. More examples would include NTU Ventures Pte Ltd, Northwater Capital Management Inc, NUS Technology Holdings Pte Ltd, McLean Watson Capital, Marqera Ltd, The North East Technology Fund LP, innoveas AG and venyard GmbH.

520 Management of Investment Products based on Royalty Liquidation/Streams

Included in the intellectual property rights finance category are also organizations that seek to create intellectual property rights investment vehicles operating similarly to the funds described previously. They bundle valuable IPR, license it out and secure the royalty streams. From the royalties received they pay back interest payments to investors. This process allows investors to earn revenue purely from royalties (FTC, 2008; JPO, 2008a, 2008b).

The investors of royalty liquidation streams are promised above average return on investment from selective, targeted or large-scale patent purchases with the goal of instituting licensing programs (Solomon and Marcowitz-Bitton, 2014). It differs from another service (510) in that the revenue is not earned from extracting money from patents but by employing various arbitrage strategies frequently involving litigation. In the royalty liquidation funds case, the payments that the investors are paid back is a percentage of collected (future) royalty payments. Intellectual property rights based structured royalty-based finance service example is DRI Capital - an investment management company, focused on investing in royalty streams in the healthcare industry, managing over 1 billion euros. DRI Capital's Royalty Monetization Fund acquires existing royalty streams from companies, research institutions and inventors (Yurkerwich, 2008). It has acquired over 800 million euros in royalty-based cash flows on commercialized products (DRI Capital, 2008). Other examples would include Acacia Research Corporation, Altitude Capital Partners, Clou Partners GmbH, HealthCare Royalty Partners, IgniteIP LLC, Royalty Pharma and Walker Digital LLC. These service providers are defined as *"Services related to the counsel, assistance and/or providing capital to patent owners performing IPR securitization financing transactions (which resemble the more common mortgage-backed securities)".*

530 Financing IPR and Innovation Processes

Entities under the intellectual property rights finance category include those which raise money from investors and loan the money to companies that own valuable intellectual property rights instead of purchasing the intellectual property rights from companies. IPR owners can use the money they receive to reinvest in their product lines, develop

new technologies, or finance other strategic initiatives. Thus this intellectual property rights-centric financing model has a potential to support innovative companies and individuals that own prospective intellectual property rights but do not have enough capital to invest in further research and development activity to develop further technology and innovations (Yanagisawa and Guellec, 2009). This service is defined as *"Providing capital for IPR creation and aggregation. Includes loan based (backed by IPR) financing".*

Valuable intellectual property rights such as patents, trademarks, and copyrights stay in the hands of the companies. There are three various financing services under the 530 category on IPR service market.

Private financiers of intellectual property rights and innovation processes are defined as *"Service of providing private financing for IPR owners, either directly or as intermediaries, usually in the form of loans (debt financing), where the security for the loan is either wholly or partially IP assets (i.e., IPR collateralization)"*. Examples include Blueprint Ventures, CAPITAL4IP SA, EurA Consult AG, Floor Swart Inc, GENIMA GmbH, GENIUS Venture Capital GmbH and affin berlin GmbH. IPR service providers that offer public financial support for innovation processes, mostly through being a partner in public incentive programs, among their services are ATHENA Technologie Beratung GmbH, BTI Technologieagentur Dresden GmbH, rubitec GmbH and ipal Berlin GmbH and are defined as "*Similar to private funding (see 531), government funding to develop further specific technology areas or promote certain technologies*" .

Private-public partnership finance providers (533 PPP Financing) include China Technology Exchange, Innovation Network Corporation of Japan and The North East Technology Fund LP and are defined as "*Similarly to private funding (see 531), the composition of public and private funding for IPR creation".*

540 IPR Litigation Funding

Outsourcing patent litigation gives operating companies the chance to monetize their rights at low cost and can also allow them to shape their competitive environments. Litigation funding firms raise money either from large technology companies, the capital markets or from institutional investors and sometimes also from high-net-worth individuals for proceedings in court (Millien and Laurie, 2008). Companies have

understood that they do not even need to own IPRs in order to consequently benefit from their exploitation by others (Ewing, 2011). This phenomenon is labeled as "IP privateering" and this practice is executed by the service providers categorized under 540. Based on ownership agreements, the intellectual property rights owners can assert intellectual property rights infringement accusations against other parties or launch licensing programs with the financial help of intellectual property rights litigation finance service providers. The services are categorized under 540 IPR Litigation Funding and defined as *"Litigation funders provide financial means for IPR litigation and particularly patent litigation cases for a fixed fee or percentage on the amount gained from infringing party".* The goal of intellectual property rights litigation funding is to acquire a financial interest generated from the borrowers' intellectual property rights exploitation activities such as patent infringement litigation and patent licensing. Intellectual property rights litigation financiers typically operate as general partners of a limited partnership (Altitude Capital Partners, 2007; Yanagisawa and Guellec, 2009). By definition, their incentives are to assemble relevant intellectual property rights at the lowest possible cost to defend their subscribers, not to maximize the value of the patents they acquire. Consequently, they are likely to exacerbate the bargaining and information asymmetries between small patent owners and multinationals, a similar effect to that of traditional cross-licensing practice (Hagiu and Yoffie, 2013). Firms such as Rembrandt IP Management LLC, BOCA Advisory Services Inc, NW Patent Funding, IgniteIP, IP Navigation Group LLC, JaNSOME IP Management LLC, Coller IP Capital are prime examples of this category.

550 IPR Insurance

Intellectual property insurance functions similarly to other forms of insurance and operates on an occurrence basis. This means that the infringement must have occurred during the period the policy was held, the insurer must be notified during that period, and any legal proceedings must be started during the same period. Intellectual property insurance providers offer protection for inventors. The definition is *"Intellectual Property Insurance service protects companies from copyright, trademark or patent infringement claims arising out of the company's operation. It pays the defense costs and any judgment up to the policy limits".* Intellectual property litigation Insurance for Inventors is subcategorized under 551 and defined as *"Insurance focused on inventors that cover*

legal fees for claiming and litigating their own intellectual property rights. IPR coverage helps pay the legal expenses of suing an individual or firm that has violated your intellectual property rights". This service helps to pay the legal expenses of suing an individual or firm that has violated one's ownership rights. Charles Milnes and Company Ltd Intellectual Property Insurances, Gesellschaft für Marken- und Patentrechtsschutzversicherung Vertriebsgesellschaft mbH and InsureCast provide such service for inventors. In cases of third party intellectual property insurance coverage, it protects the covered party if they are sued for infringing on another party's intellectual property rights. In that case, the service provider funds the covered party's legal defense. The insurance provider pays the defense costs. It can also cover any judgment up to the policy limits. Policies vary among various intellectual property insurance service providers. RPX Insurance Services LLC is one of the third party covering insurance providers. The definition for 552 is "*Insurances that cover legal fees related to IPR litigation. Third party coverage protects the client in case of infringing on another party's intellectual property rights and it usually funds legal defense costs for the client*".

600 IPR-related Communication Service

Various interests are involved when structuring intellectual property rights markets and thus individuals from various levels are engaged in reshaping intellectual property rights markets. Category 600 includes all the educational, HR and PR-related services and are defined as *"The collective communication outlets or tools that are used to store and deliver information on IPR related topics or data, like publications, journals, blogs and educational materials. Additionally, the correspondents of IPR related issues like unions and IP interest groups".*

610 IPR-related Education and Publishing

Governments and public organizations in many countries are providing a number of programs aimed at fostering the marketplaces for intellectual property rights. Considering the importance of such marketplaces as a driving force for diffusion of technology and ideas; Ailpa, Anaqua Inc, ARSiS Consulting, Electronic Frontier Foundation, FICPI, Freeman IP Ltd and official patent offices world-wide (e.g. EPO, WIPO, and IPO UK) offer such services. These services are defined as *"Services based on*

specialized education and publishing of IP-related topics and non-academic publishers specialized in IP topics". Many of the services under this category refer to the wider meaning of IP and therefore it is important to note that category 600 is not focused on patents only.

Education related services are under category 611 and are defined as *"Services based on specialized IP education and publishing of IP related topics".* All publication houses and entities are categorized under 612 and defined as *"(Online) Journals focusing on IPR related topics. Includes internet blogs"*. If online courses are offered, the service would fall under 613 E-learning Solutions for IP category *"Internet-based education and online courses about intellectual property rights and related issues".* There are various conferences and seminars on IP topics. Some of them are mentioned in the methodology Knowledge Acquisition phase – all these events would fall under "614 Organization and Execution of Meetings Specialized in IP Topics" with a corresponding definition of *"Gatherings or meetings for IP consultation, exchange of IP related information, or discussion, especially ones with a formal agenda on IP related topics"*. Programs specialized on intellectual property rights related topics range from convening conferences, workshops and seminars focusing on various intellectual property topics, to summits targeted for industry only (IP Service World Munich annual conference) or to specific industry groups like green technologies (Cleantech Intellectual Property Law Forum at New Energy Symposium in NYC). Association of University Technology Managers, Bayerische Patentallianz GmbH, B&R Soluciones Legales Ltd., AIPLA, China IPR SME Helpdesk are few of the organizations organizing these.

Scientific output from research institutions on IP topics can be seen as a service to society, trying to educate and build the IP culture. This kind of service is defined as *"Scientific research and publications in the fields of intellectual property (mostly in an economic or legal perspective)"* and categorized as 615 IP-related Scientific Research. The European Commission has been giving out research grants for intellectual property rights related scientific works. One of the good examples of funding public research on IPR topics has been the annual meeting held in Seville at EC Institute for Prospective Technological Studies (IPTS) and since 2014 in Brussels and OECD IP statistics events in Paris, where highest level researchers gather to share their research insights every year. IPTS, OECD (Patent Statistics for Decision Makers), Center for Patent Policy, Fraunhofer

Group are some examples of institutes that support public research on intellectual property rights.

620 IP Software

IP software is another way to communicate analysis outputs for interested parties. The value of IPR has received more and more importance. Therefore, companies seek to understand the IPR topic better and are investing more time into understanding the significance and worth of IPR. IP-related decision making has become more and more asset based (Mikk Putk, 2013). Many technology producers use various IT based assets to educate themselves and investigate IP developments. Different kinds of software are used to monitor and observe the IPR developments. All these various kinds of IT solutions for communicating for and assisting with decision making are collected under category 620. The category is defined as *"Various IT solutions and data stored electronically and created for processing and evaluating patents and IP-related features".*

Under this category belongs rating, analyzing, managing and valuation software. Firstly, the 621 In-house IP Portfolio Management Software that offers easy solutions to keep track of technology companies´ IPR portfolio. The service is defined as *"Software for managing IPR portfolio (e.g. licensing and collecting royalties, application and renewal support, IPR decision management or IP portfolio related business intelligence solutions)".*

622 IPR Portfolio Management Software for Attorneys, defined as *"Specialized IP portfolio management software for patent attorneys"* is a separate category in the IPSC. Because much of the currently existing software requires specialized knowhow and is not adopted for users that lack the background legal knowhow related to IP portfolio management 622 is classified separately. 623 IP Valuation Software focuses on measuring the strength and monetary value (e.g. Monte Carlo simulations for patent valuation). All software that tries to measure the IPR portfolio according to some metrics is defined as *"Software that evaluates or supports the valuation of patents and/or portfolios".* All these various IPR service providers create tools to measure the quality of arguably the largest part of those intangible assets. Another important software type is software for searching patent databases categorized in this work 624 IPR Search

Software and defined as *"Software or web-based platforms for searching patent databases (EPO, DPMA, USPTO, JPO). Includes further examining and monitoring of patent databases and providing patent information."*

The creation of formalized stock indexes based on intellectual property software analytics helps investors to make better investment decisions. The patent rating software and IP service industry have made speculations that investing in stocks with valuable patents might mean for investors making more meaningful investment decisions and by investing into stock with strong IPR it is possible to outperform other investment strategies. Therefore, these service providers under category 625 build different algorithms to create pools of stocks evaluating first the quality of a publicly traded company's patents as the primary selection factor of where to invest. Basically, they evaluate the traded companies IPR portfolios and based on that evaluation they give investment recommendations via the patent-based public stock indexes. Such services are defined as *"Stock indexes that are based on aggregated patent and technology value"*. These service providers generate their income by selling equity research and by licensing such indexes (e.g. Ocean Tomo Indexes, Patent Board WSJ Scorecard) to mutual funds and/or other investable financial instrument issuers (Millien and Laurie, 2008).

630 Patent Database

Most of the software is built on data. The software can offer automated analytics for its users. The service providers who enable the use of data are defined as *"Service related to the organized collection of IPR related data, today typically in digital form. The data are typically organized to model relevant aspects of patents, intellectual property, and protected technology in a way that supports processes requiring patent related information"*. The basic patent document data platforms are 631 Providing Patent Document Data, defined as *"Services related to collecting data on patents"*. They give an overview of active patents. Various platforms are offering services of finding litigation cases (632 Providing Data about IP Litigation) that are defined as *"Services related to collecting data on IP law cases"*. Intellectual property authorities, who have the rights to grant patents have patent databases as well and they are categorized as 633 Official Design, Patent and Trademark Data provided by Industrial Property and Trademark

Offices with a definition of *"Official design, trademark and patent databases"*. A good example would be Espacenet EPO database. Private initiatives like Covington Burling LLP, CleanTech PatentEdge, Pantros IP Inc, Patent Buddy LLC, Patent People Inc, PatentBlast.com Inc and Patinformatics LLC are good examples for 631 and 632.

640 IP-centric HR Service

Recruiting services have specialized in finding professionals with specific intellectual property rights related competencies. These recruiting efforts are defined as *"Headhunting and scouting services specialized on persons in the field of intellectual property. It includes services that help to recognize outstanding inventors among other IP community members, HR recruitment platforms and conferences on IP related topics for HR people for networking purposes"* and categorized as 640 IPR-centric HR Service. The specialization of such HR services could be explained by the high complexity and constant evolution of intellectual property rights related issues and topics that require professionals to update their expertise regularly. There are special purpose platforms looking for IP experts (641 Matching IP Professionals and Companies through Online Platforms) defined as *"Online platform posting IP expert vacancies".* Offline activities belong in the category (642 Matching IP Professionals and Companies as HR Agency) and are defined as *"Headhunting services for finding IP experts".* Finding the right expert service is delivered by IP Industry Base, IPHire, IPWatchdog.com, National Association of Patent Practitioners and PatentSalon.com.

650 Interest Group, Political Work

While governments are funding research that helps to advance intellectual property rights markets and is trying to make appropriate policies in order to promote businesses and transparency on IPR markets, lobbying for certain intellectual property rights related policies is mostly done by groups of companies or associations of professionals. The experts are categorized as "650 Interest Group, Political Work" and defined as "*Organizations with IPR related political or legal strategies as their main topic. Excludes associations of IP professionals".* American Innovators for Patent Reform, AIPLA, CACP, Deutscher Verband für Technologietransfer und Innovation e.V., European Policy for Intellectual Property, IP Justice and Patent Documentation Group are examples.

660 Association of IPR Professionals

Creating expert groups for revising relevant legislation and formulating guidelines for IPR licensing has been in government focus for years (OECD, 2006a). Establishing expert groups based on competences of private individuals to improve scientific work is also a common practice. American Bar Association, Association of Intellectual Property Firms, Association of University Technology Managers, Licensing Executives Society Deutsche Landesgruppe e.V. (a subgroup of International and National Association of Patent Practitioners) are good examples. These services of bringing experts together are defined as *"Networks and associations of professionals with business or academic interest in IP. Includes academic research groups and bar associations. Typically, non-profit organizations".*

5.5. Integration

In the last chapter, the formalization of the IPSC, where the complete set of IPR services to date classified and structured as required by ontological engineering process was presented. The next step is the matching of previous works (typologies, taxonomies, ontologies) that have tried to classify IPR market players with IPSC. The matching of the IPR services can be found in the tables below:

Terms used for IPR service providers by Millien (2013)	**Corresponding services in the IPSC**
Patent Licensing and Enforcement Companies (PLECs)	371 Offensive IPR Aggregation 320 IPR Brokerage 450 Licensing IPR 510 Investment Products Based on IPR 390 Purchase and Sale of IPR
Privateers	372 Defensive IP aggregation 441 IP Augmentation Through In-house Labs 370 IPR Pooling/Aggregation 390 Purchase and Sale of IPR 450 Licensing IPR

Terms used for IPR service providers by Millien (2013)	**Corresponding services in the IPSC**
Institutional IP Aggregators/Acquisition Funds	510 Investment Products Based on IPR 371 Offensive IPR Aggregation 372 Defensive IPR Aggregation 441 IP Augmentation Through In-house Labs 442 IPR Augmentation Through Outsourcing 390 Purchase and Sale of IPR 450 Licensing IPR
IP/Technology Development Companies	370 IPR Pooling/Aggregation 265 Technology Development 440 IPR Augmentation 450 Licensing IPR
Licensing Agents	450 Licensing IPR 121 Due Diligence 122 Transaction Support 320 IPR Brokerage 330 IPR Scouting
Litigation Finance/Investment Firms	531 Private Financing 510 Management of Investment Products based on IPR 520 Management of Investment Products based on Royalty Liquidation/streams 540 Litigation Funding
IP Brokers	320 IPR Brokerage 310 IPR Scouting 122 Transaction Support
IP-Based M&A Advisory Firms	380 IP-driven M&A Advisory
IP Auction Houses	341 Onsite IPR Auction
On-Line IP/Technology Exchanges, Clearinghouses, Bulletin Boards, and Innovation Portals	312 Online Matchmaking Platform 342 Online IPR Auction 350 IPR Exchange
IP-Backed Lending Firms	510 Management of Investment Products based on IPR 530 Financing IPR and Innovation Processes

Terms used for IPR service providers by Millien (2013)	**Corresponding services in the IPSC**
Royalty Stream Securitization Firms	520 Management of Investment Products based on Royalty Liquidation/streams
Analytics Software and Services Firms	620 IP Software 631 Patent document data 111 Patent, Design and Trademark Searches 121 Due Diligence 210 Portfolio Analysis 240 Competitive Intelligence 630 IP Database
University Technology Transfer Intermediaries	220 IP Strategy Development 450 Licensing IPR 311 Onsite Matchmaking 390 IPR Purchase and Sale
IP Transaction Exchanges & Trading Platforms/IP Transaction Best Practices Development Communities	350 IPR Exchanges 312 Online Matchmaking
Defensive Patent Pools, Funds and Alliances	390 Purchase and Sale of IPR 372 Defensive IPR aggregation 450 Licensing IPR
Technology/IP Spinout Financing Firms	230 Commercialization Support 510 Management of Investment Products based on IPR 531 Private Financing
Patent-Based Public Stock Index Publishers	612 IP related Publication 625 Patent-based Public Stock Index
IP Insurance Carriers	550 IP Insurance

Table 12 Table of Matching Millien (2013) Research with the IPSC

A recent study on IPR Service providers by Hagiu and Yoffie (2013) suggests a list of middlemen providing IPR services. The services in the IPSC that are offered by the IPR Service providers defined by Hagiu and Yoffie (2013) are integrated in the following manner:

Terms used for IPR service providers by Hagiu and Yoffie (2013)	**Corresponding services in the IPSC**
Patent brokers	320 IPR Brokerage 310 IPR Scouting 122 Transaction Support
Patent pools	370 IPR Pooling/Aggregation 450 Licensing IPR 420 IP Portfolio Management 430 IP Portfolio Administration
Standard-setting Organizations	450 Licensing IPR
Non-Practicing Entities	390 Purchase and Sale of IPR 450 Licensing IPR 371 Offensive IPR Pooling/Aggregation
Patent Trolls	390 Purchase and Sale of IPR 452 Stick Licensing 371 Offensive IPR Pooling/Aggregation
Two-sided Patent Platforms	312 Online Matchmaking Platform 311 Onsite Matchmaking 341 Onsite IPR Auction 342 Online IPR Auction 320 IPR Brokerage 310 IPR Scouting
Defensive Aggregators	372 Defensive IPR Pooling/Aggregation 450 Licensing IPR 390 Purchase and Sale of IPR
Super Aggregators	371 Offensive IPR Pooling/Aggregation 372 Offensive IPR Pooling/Aggregation 390 Purchase and Sale of IPR 450 Licensing IPR 510 Management of Investment Products based on IPR 441 IP Augmentation through In-House Labs

Table 13 Table of Matching Hagiu and Yoffie (2013) Research with the IPSC

Earlier work of Yanagisawa and Guellec (2009) listed IPR related services. They elaborated further the activities of middlemen. The elaborated terms with IPSC defined services are integrated in the following manner:

Terms used for IPR service providers by Yanagisawa and Guellec (2009)		**Corresponding services in the IPSC**
	(Elaborated terms)	
IP management support	IP strategy advice	220 IP Strategy Development 330 IPR Scouting 320 IPR Brokerage
	Patent evaluation	211 Legal Quality Assessment 212 IPR Valuation 242 Technology Analysis 243 Patent analysis
	Portfolio analysis	213 IP Portfolio Landscaping 241 Industry Analysis 243 Patent analysis
	Licensing strategy advice	220 IP Strategy Development 450 Licensing IPR 121 Due Diligence 122 Transaction Support 320 IPR Brokerage 330 IPR Scouting
	Patent infringement analysis	261 Infringement Intelligence 262 Technical Infringement Analysis 131 Non-jud. Proceedings

Terms used for IPR service providers by Yanagisawa and Guellec (2009)		**Corresponding services in the IPSC**
	(Elaborated terms)	
IP trading mechanism	Patent license/transfer brokerage	320 IPR Brokerage 310 IPR Scouting 122 Transaction Support
	Online IP marketplace	312 Online Matchmaking Platform 342 Online IPR Auction
	IP live auction/online IP auction, IP license-right trading market	341 Onsite IPR Auction 342 Online IPR Auction 311 Onsite Matchmaking 312 Online Matchmaking
	University technology transfer	311 Onsite Matchmaking 312 Online Matchmaking 450 Licensing IPR 390 Purchase and Sale of IPR
IP portfolio building and licensing	Patent pool administration	370 IPR Pooling/Aggregation 420 IP Portfolio Management 430 IP Portfolio Administration
	IP/Technology development and licensing	370 IP Pooling/Aggregation 265 Technology Development 440 IPR Augmentation 450 Licensing IPR
	IP aggregation and licensing	370 IP Pooling/Aggregation 390 Purchase and Sale of IPR 440 IP Augmentation 450 Licensing IP 330 IPR Scouting 320 IP Brokerage
Defensive patent aggregation/Framework for patent sharing	Defensive patent aggregation funds and alliances	372 Defensive IPR Aggregation 265 Technology Development
	Initiative for free sharing of pledged patents	361 Defensive Publishing 362 (Online) IPR Pools for Public Use

Terms used for IPR service providers by Yanagisawa and Guellec (2009)		**Corresponding services in the IPSC**
	(Elaborated terms)	
IP-based financing	IP-backed lending	531 Private Financing 532 Public Funding 533 PPP Financing 540 IPR Litigation Funding
	Innovation investment fund	531 Private Financing 532 Public Funding 533 PPP Financing
	IP-structured finance	531 Private Financing 510 Management of Investment Products based on IPR 520 Management of Investment Products based on Royalty Streams/Licensing
	Investment in IP-intensive companies	540 IPR Litigation Funding 531 Private Financing 532 Public Funding 533 PPP Financing 350 IPR Exchange

Table 14 Table of Matching Yanagisawa and Guellec (2009) Research with the IPSC

Howells (2006) research classified the various services into ten different concepts. The service providers for such services would arrange from government bodies to industry and have been matched as follows:

Terms used for IPR services by Howells (2006)		**Corresponding services in the IPSC**
	(Elaborated terms)	
Foresight and diagnostics	Technology foresight and forecasting	211 Patent Analysis 213 Portfolio Landscaping
	Articulation of needs and requirements	380 IP-driven M&A Advisory
Scanning and information processing	Scanning and technology intelligence	111 Patent and Trademark Search 211 Patent Analysis 330 IPR Scouting
	Scoping and filtering	311 Onsite Matchmaking Service 320 IPR Brokerage
Knowledge processing, generation and combination	Combinatorial	121 Due Diligence 213 Portfolio Landscaping 220 IP Strategy Development
	Generation and recombination	441 IPR Augmentation through In-House Labs
Gatekeeping and brokering	Matchmaking and brokering	121 Due Diligence 122 IPR Transaction Support 320 IPR Brokerage
	Contractual Advice	122 IPR Transaction Support 320 IPR Brokerage
Testing, validation and training	Testing, diagnostics, analysis and inspection	211 Legal Quality Assessment 230 Commercialization Support 262 Technical Infringement Analysis
	Prototyping and pilot facilities	230 Commercialization Support
	Scale-up	230 Commercialization Support
	Validation	212 IPR Valuation
	Training	230 Commercialization Support

Terms used for IPR services by Howells (2006)		**Corresponding services in the IPSC**
	(Elaborated terms)	
Accreditation and standards	Specification setter or providing standards advice, Formal standard setting and verification, Voluntary and de facto standards setter	150 Standardization
Regulation and arbitration	Regulation	140 IPR-granting 160 Anti-Trust and Competition Law Enforcement
	Self-regulation	
	Informal regulation and arbitration	160 Anti-Trust and Competition Law Enforcement
Intellectual property: protecting the results	Intellectual property (IP) rights advice	111 Patent and Trademark Search 112 Patent Drafting
	IP management for clients	113 Application and Renewal of IPR 430 IP Portfolio Administration
Commercialization: exploiting the outcomes	Marketing support and planning	213 IP Portfolio Landscaping 220 IP Strategy Development 230 Commercialization Support
	Sales network and selling	230 Commercialization Support 390 Purchase and Sale of IPR 450 Licensing IPR
	Finding potential capital funding and organizing funding for offerings	212 IPR Valuation 530 Financing IPR and Innovation Processes
	Untitled: Follow on funding, VC and IPO	380 IP-driven M&A Advisory 510 Management of Investment Products based on IPR 520 Management of

Terms used for IPR services by Howells (2006)		Corresponding services in the IPSC
	(Elaborated terms)	
		Investment Products based on Royalty Liquidation/Streams 530 Financing IPR and Innovation Processes
Assessment and evaluation	Technology assessment	211 Legal Quality Assessment 212 IPR Valuation
	Technology evaluation	211 Legal Quality Assessment 212 IPR Valuation 262 Technical Infringement Analysis (Software/Circuits)

Table 15 Table of Matching Howells (2006) Research with the IPSC

From the "integration" step of the methodology it can be clearly concluded that the IPSC is the first step to building a constructive and comprehensive categorization of all IPR services on IPR markets. The most comprehensive set of distinguished IPR services that can be identified on innovation markets is the IPSC. The IPSC distinguishes seventy-two various IPR related services. The typologies published earlier are scattered overviews of mainly new or emerging IP business models. By combining empirical work (mapping over 4,100 IPR service providers) and human judgment (forty-two interviews, plus one-day workshop) a taxonomy covering all possible IPR services, the IPSC, is the most comprehensive one developed in research thus far.

5.6. Evaluation

In the spring of 2012, the very first evaluation of the primary IPSC took place (please see Appendix 3 for the initial concept of the IPSC). The goal of the first evaluation process was to determine if the users of the IPR related services share the understanding of the terminology and structure of the first IPSC created within the Competitive Intelligence group at Fraunhofer IMW. It was important to present the full range of

information in each evaluation step because IPSC was not only meant for people with mathematical modeling or information science background. The IPSC was meant to be used by a broader audience, namely C-level executives, IPR service providers themselves and all the other necessary stakeholders, like government institutions.

Once initial definitions and structure were done in the planning phase of the IPSC, in-depth telephone interviews were conducted with representatives from twenty-six technology companies for evaluation purposes. Clean technology companies were chosen due to their fit for the study. Several company sets from Fraunhofer IMW info-pool were contacted, but when half declined the offers to participate in the study the set was dropped. The most comprehensive set available for an approximately one-hour interview each was the above mentioned one.

Many of the company managers felt that IP management adds barriers to their core business-technology productions and therefore they were highly motivated to help us create a registry of all possible IPR services. Respondents were identified from Fraunhofer IMW´s previous research partners and from an Internet search. Clean technology company owners, CEOs or intellectual property managers of various clean technology companies, such as from recycling business to environmentally sound transportation providers were recruited. Clean technology producers, clean service related processes providers as well as clean technology machinery producers were included into the sample as well. Respondents included one founder not operating as current CEO, eleven CEOs, two CFOs, six R&D managers, three intellectual property managers and two operations managers. Types of clean technology companies included: two fuel cell systems producers, five energy efficient vehicles/motor producers, four smart home/building companies, two waste management firms, ten clean energy converters/producers, two green materials (plastic, wood) producers and one semiconductor company:

Person	Company	IPIB Link /Type of Company	Employees
Shaun Fitzgerald (CEO)	Breathing Buildings Ltd	Provides low energy ventilation systems, using the principles of natural mixing ventilation in winter and natural upward displacement ventilation in summer. From Cambridge, UK.	30
Alexey Matveev (Research manager)	SmartMotor	SmartMotor manufactures Energy Efficient Motors (EEM) based on magnetic technologies that allows superior efficiency, more torque, and less noise production. From Norway.	34
Michele Pennese (R&D director)	Micro-Vett	Designs and manufactures a complete range of electric vehicles Working closely with large-scale vehicle manufacturers (FIAT, Piaggio and Iveco) and research institutes. From Italy.	55
Ilaria Rosso (R&D director)	Electro Power Systems	Electro Power Systems develops, produces and markets fuel cell systems for power back-up. From Italy.	35
Daniel Ninan	Intelligent Energy	Intelligent Energy develops clean power systems based on proprietary fuel cell and hydrogen generation technology platforms to create bespoke power systems for OEMs and their global mass markets. From the UK.	101
Moritz von Plate (CFO)	Solarlite	Develops and builds decentralized solar thermal parabolic trough plants (CSP concentrated solar power) for combined heat and power generation. From Germany.	180
Jonathan Short (CEO)	Eco Plastics	Reprocesses post-consumer waste plastics, accepting mixed plastic bottles sorting them by color and polymer. From the UK.	50

Person	Company	IPIB Link /Type of Company	Employees
Marco van der Hijden (Marketing manager) and Marieke Andringa (Legal Counsel)	Green Gas International	Green Gas International converts methane emissions from coal mines and landfills into clean energy and carbon credits. From the Netherlands.	499
Dr. Vincent Guenebaut (Head of product development)	Nualight	LED lighting company specialized exclusively in lighting for food retail displays Customer base includes Tesco, Carrefour, Migros, Sainsburys etc. From Ireland.	80
Alan South	Solarcentury	Solarcentury operates as a solar energy company which designs and supplies solar energy solutions. Solarcentury offers support and guidance throughout the entire micro renewable planning and development process, from land appraisal through to design, installation and marketing. From the UK.	200
Jeremy Ellison (CFO)	Ashwood Automotives	Ashwoods Automotive is a provider of hybrid-electric vans and hybrid drive systems. The company's hybrid vans are proven to reduce emissions and fuel cost by over 15% com-pared with the equivalent diesel variant. From the UK.	15
Naomi Aptowitzer (CEO)	ZiPee Bikes	ZiPee Bikes offers electric bikes targeting short trips of under 20 miles. From the UK.	4
Thomas Almesjö (CEO)	ChromoGenics	ChromoGenics has an internationally leading position for electrochromic materials, and many years of research at the Ångström Laboratory has led to a unique technology and patent portfolio. From Sweden.	20

Person	Company	IPIB Link /Type of Company	Employees
Philipp Degenhardt (Research and Development Engineer)	PowerWind	Focuses on community-scale wind projects (1-30MW and mostly locally owned). 5,000 m² manufacturing facility with two production lines. From Germany.	140
Fabien Michel (Deputy General Manager)	Enertime	Offers turn-key solutions for the industrial scale distributed renewable electricity and heat production with biomass, waste heat, and thermodynamic solar and geothermal sources. From France.	11
Per Olofsson (CEO)	Climatewell	ClimateWell develops, produces, and markets indoor climate solutions for the use in residential, commercial, and industrial structures. From Sweden.	63
Jens Muttersbach (CEO)	Sensima Technology SA	Sensima Technology SA is a semiconductor company specialized in the design and distribution of fully integrated CMOS magnetic sensors. From Switzerland.	10
Emma Gibson (Operations Manager)	Highview Power Storage	Highview Power Storage is a developer of utility-scale energy storage and power systems to optimize energy resources and help decarbonize the grid. From the UK.	40
John O'Regan (Operations Manager)	SCFI Group Ltd.	SCFI has developed technology called AquaCritox® which can completely destroy organic waste and generate renewable energy. liquid organic wastes. From Ireland.	60
Steve Jenkins (IP Manager)	Xeros Ltd.	Xeros Ltd. is a new company focused on the development of "virtually waterless" laundry cleaning. From the UK.	26

Person	Company	IPIB Link /Type of Company	Employees
Lars Mach (CEO)	Goliath Wind	GOLIATH Wind introduces a generation of wind turbines that takes gearless drive train to a new level. From Estonia.	40
Andreas Härberle (CEO)	PSE	PSE specialises in technology and consulting in the field of solar energy. From Germany.	84
Thomas Helbling (head of R&D)	greenTEG	greenTEG GmbH develops the new generation of thermoelectric generators. From Switzerland.	15
Per Brynildsen (CTO)	Kebony	Kebony is a wood processing company. Its unique process method is based on a practice where sustainable wood is made more durable, harder and more stable using liquids from bio waste material. From Norway.	53
Wilco van Hoogstraeten (CTO)	GreenPeak	GreenPeak Technologies offers innovative ultra-low power wireless RF communication controller chips for the Smart Home. From Netherlands.	40
Thomas Leiber (Founder)	CPM Compact Power Motors GmbH	CPM develops and manufactures the world's most efficient and compact drive solutions, all made in Germany. From Germany.	15

Table 16 Interview Partners and Company Specifications

The interviewees where asked to elaborate on the importance of the IPR related services and were asked which services are used by them. Prior to the interviews, the respondents were asked to get acquainted with the IPSC to suggest changes to the wording and to the structure. The technology company representatives stated which of the IPR services they use the most – which resulted in the initial order of the main categories being changed. They were asked to comment on the initial version of the IPSC and to suggest changes. Finally, the interview partners were asked if they believed

that their industry stands out in some way related to IPR services. No difference was mentioned by the clean technology companies. The interviewees found themselves similar to all other industries with regards to the IPR services. The first interview partner profiles, questions, and synopsis of interview results can be found in Appendix 5 and 6. After the first set of interviews, the IPSC and the terminology pool was analyzed and conceptualized.

In the last quarter of 2013 and early 2014, the second set of in-depth telephone interviews were conducted with IPR service provider companies. Sixteen IPR service providers were contacted worldwide. The average duration of the interview was one hour. The interviews were conducted to understand the current IPR service market terminology, problems, to validate the IPSC and to understand if the IPSC could help to mitigate some IPR service market problems. The IPR experts were asked to refine the IPSC and were asked to elaborate on possible future changes on IPR service market. The full list of the second interview questions including notes can be found in Appendix 7.

All the experts worldwide were presented the IPSC which was sent to interview partners before the interviews took place in order to have coherent thinking between the experts and for easier feedback collection. Respondents were identified from previous Fraunhofer research partners and from an Internet search. Respondents included IPR firms specialized in law related matters, IPR finance, brokerage and IPR strategy experts. The companies where asked to elaborate on the biggest problems of IPR market and possible solutions.

Person	Company	IPIB Link /Type of Company	Employees
Joni Sayeler	Uppdragshuset Sverige AB	http://ipib.ci.moez.fraunhofer.de/companies/uppdragshuset-ab IP Portfolio Analysis, Competitive Intelligence, IP Strategy Development, Patent Searches	11-50
Raj Mendhir	ICEBERG Capital Partners Ltd	http://ipib.ci.moez.fraunhofer.de/companies/iceberg-innovation-capital-ltd IP Brokerage, Purchase and Sale of IP, Licensing, IP Strategy Development, Competitive Intelligence, IP Contracting	11-50
Paolo Foà	Notarbartolo & Gervasi	http://ipib.ci.moez.fraunhofer.de/companies/notarbartolo-and-gervasi IP Protection, IP Contracting, IP Litigation, IP Portfolio Analysis	11-50
Raymond Millien	GE Healthcare	Research (Licensing, Purchase and Sale)	over 10,000
Josep Maria Pujals	Oficina Ponti	IP Protection, IP Contracting, IP Litigation, Education, IP Portfolio Analysis	11-50
Manfred Plischke	Euro IP Strategy Consulting GmbH	http://ipib.ci.moez.fraunhofer.de/companies/eipsc IP Portfolio Analysis, Competitive Intelligence, IP Strategy Development, IP Commercialisation, Internationalisation Support	1-10
Anant Kataria	Sagacious Research Pvt Ltd	http://ipib.ci.moez.fraunhofer.de/companies/sagacious-research IP Protection, IP Contracting, IP Brokerage, IP Portfolio Management, IP Portfolio Analysis, Competitive Intelligence, Fighting Infringement and Counterfeiting, IP-driven M&A Advisory, IP Commercialisation	1-10
Craig O'Dell	Valipat SA	http://ipib.ci.moez.fraunhofer.de/companies/valipat-sa IP Document Processing, IP Software, IP Protection	51-200

Person	Company	IPIB Link /Type of Company	Employees
Xiaodong Li	Beijing East IP Ltd	http://ipib.ci.moez.fraunhofer.de/companies/beijing-east-ip-ltd IP Protection, IP Contracting, IP Litigation, IP Portfolio Analysis, IP Portfolio Management, IP Strategy Development, Fighting Infringement and Counterfeiting	51-200
Alexander Korenberg	Kilburn & Strode LLP	http://ipib.ci.moez.fraunhofer.de/companies/kilburn-and-strode-llp IP Protection, IP Contracting, IP Litigation, IP Portfolio Analysis, IP Portfolio Management, IP Strategy Development, Fighting Infringement and Counterfeiting	51-200
Henry Suzuki	Axonal Technology Consulting Ltd	IP Protection, IP Contracting, IP Financing, IP Brokerage, IP Document Processing, Education	1-10
Mikk Putk	Sarap & Putk	http://ipib.ci.moez.fraunhofer.de/companies/sarap-and-partners IP Protection, IP Contracting, IP Litigation, IP Portfolio Analysis, IP Strategy Development, Competitive Intelligence	1-10
Jonas Severin Frank	Philips Universität Marburg	IP related scientific Research	over 10,000
Gary Ling	HKIPEx.com.hk Ltd	http://ipib.ci.moez.fraunhofer.de/companies/hkipex-dot-com-dot-hk Matchmaking, IP Exchange, IP Software	11-50
Akos Sule	Sule Law	http://ipib.ci.moez.fraunhofer.de/companies/sule-law IP Protection, IP Contracting, IP Litigation, IP Document Processing, IP Strategy Development	1-10
Taavi Raidma	Deltasight	http://ipib.ci.moez.fraunhofer.de/companies/crowdipr Matchmaking, IP Portfolio Analysis, Competitive Intelligence, Crowd-Sourcing Platform for Prior Art Search	1-10

Table 17 Interview Partners and IPR Service Provider Specification

The sixteen interviews conducted were a comprehensive evaluation work on the IPSC because the interview partners were asked to give feedback and score the accuracy of

the IPSC. A scale measure for IPSC appropriateness (1 lowest to 7 highest) was asked from each interview partner. The interviewed IPR experts gave an average score of "5,3" for IPSC coverage of services. They believed IPSC covers at least three-quarters of all the possible IPR services. Because there exists no set of data that represents all IPR service providers, it is difficult to compare and estimate if the IPSC is complete. That is one of the main limitations of the methodology. Due to data unavailability, the IPSC cannot be validated with existing data pools of IPR services. A recommendation for future work is to compare the IPR service providers' data set and matching of all services with another dataset as soon as it emerges. At the moment the IPIB is the only known comprehensive database specialized on IPR service providers according to our interview partners. However, in order to increase the IPSC coverage and accuracy, several changes were made for the IPSC based on data collected for the purpose of this thesis. As a result, most of the evaluation for IPSC relies on human judgment.

For the final evaluation step of the IPSC, an IPR expert group of Tove Graulund, John Pryor, Donal O´Connell and Thomas Hoehn (the short bios of the expert group can be found in Appendix 8) was established. On 27th March 2014 at Imperial College, a one-day workshop was organized to discuss the IPSC with the emphasis on the correct terminology. Terminology and definitions were refined and changes for the previously prepared IPSC suggested. This one full day workshop was the most challenging for the IPSC and the analyses of the results took about six months. A new structure, with new subcategories and changed definitions, was established by summer 2015. All the various versions of the IPSC that have been developed throughout three years can be found in Appendixes 3, 4 and 9.

5.7. Documentation

IPSC throughout the working period was documented in the following publications by the author:

"Clean Technology Industry: Relevance of Patents and Related Service Providers" Liina Tonisson, Lutz Maicher (March 2015) In book: Promoting Sustainable Practices through Energy Engineering and Asset Management, Edition: A volume in the Advances in Environmental Engineering and Green Technologies (AEEGT) Book Series, Chapter: 11, Publisher: IGI Global, Editors: Vincete Gonzalez-Prida, Anthony Raman, pp.263 - 286

"Intelligence on the IP Service Industry as innovative input for FTA" Liina Tonisson, Lutz Maicher (Nov 2014) Conference: 5th International Conference on Future-Oriented Technology Analysis (FTA) Engage today to shape tomorrow, At EC Brussels

"Framework to measure the performance of IP services providers" Jakub Hlavka, Lutz Maicher, Michael Prilop, Liina Tonisson (July 2014) Conference paper

"How to find the right IP expert for you?" Liina Tonisson, Lutz Maicher (April 2014) Hong-Kong IP exchange platform - HKIPEx.com.hk

"Industrializing IP Services" Lutz Maicher, Liina Tonisson (January 2014) IPR Info Magazine

"The market position of university technology transfer offices in the IP service industry" Lutz Maicher, Fabian Bartsch, Liina Tonisson, Michael Prilop (May 2013) Conference: University-Industry Interaction Conference, Amsterdam

"Designing Analytical Approaches for Interactive Competitive Intelligence" Michael Prilop, Liina Tonisson, Lutz Maicher (April 2013) International Journal of Service Science, Management, Engineering, and Technology (IJSSMET) Volume 4, Issue 2

"IPST – a classification of Intellectual Property Related Services" Liina Tonisson, Lutz Maicher (Nov 2012) Conference: Patent Statistics for Decision Makers (PSDM), Brussels, EC

"Service profiling - a method for data-driven competitive intelligence in service industries" Michael Prilop, Liina Tonisson, Lutz Maicher (January 2012) Smart Services and Service Science - Proceedings of the 4th International Symposium on Services Science, Leipzig (Germany), September 25, 2012, Leipziger Beiträge zur Informatik, Band 36, LIV/InfAI, Leipzig. ISBN: 978-3-941608-23-8.

The final taxonomy that has been applied and documented in IPIB can be found in Appendix 9. The IPIB is a database of more than 4,100 IPR service providers and a tool. It links patents, technology producers, and technology areas to more than 4,100 IPR service providers categorized according to IPSC. For each of the listed IPR service providers, the service portfolio is assigned by a set of activities from the IPSC.

5.8. Realization and Maintenance of the IPSC

First, the IPSC is maintained in the Basel library of ontologies[14]. Basel Register of Thesauri, Ontologies and Classifications is a multilingual, interdisciplinary directory of Knowledge Organization Systems and KOS related Registries is maintained by Basel University.

Secondly, IPSC has been implemented in the IPIB – the realization and maintenance platform of the IPSC. This platform allows the user to visualize, compare, retrieve and analyze firms based on their services provided in a formal and scalable way. The IPSC is maintained by SKOS representation (.xml version/ RDF format):

```
<?xml version="1.0" encoding="utf-8" ?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:skos="http://www.w3.org/2004/02/skos/core#"
         xmlns:dc11="http://purl.org/dc/elements/1.1/">

  <skos:ConceptScheme rdf:about="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#">
    <dc11:title>Services</dc11:title>
    <dc11:description>The Intellectual Property Services Classification (IPSC) defines types of business activities
that are executed by companies active in the IP services market. Each main category is divided in several
sub-categories.</dc11:description>
    <dc11:bibliographicCitation>Tonisson, L. (2016). A Comprehensive Classification of Business Activities in the Market
of Intellectual Property Rights-related Services. Dissertation, Leipzig University, fraunhofer IMW </dc11:bibliographicCitation>

    <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#400-legal-services"/>
    <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#600-ip-consultancy"/>
        <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#200-matchmaking-and-trading"/>
        <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#300-ip-portfolio-processing"/>
        <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#100-finance"/>
        <skos:hasTopConcept rdf:resource="https://ipib.ci.moez.fraunhofer.de/taxonomies/services#700-media-and-people"/>
  </skos:ConceptScheme>
```

Figure 14 Screenshot of SKOS of the IPSC

[14] http://bartoc.org/en/node/690

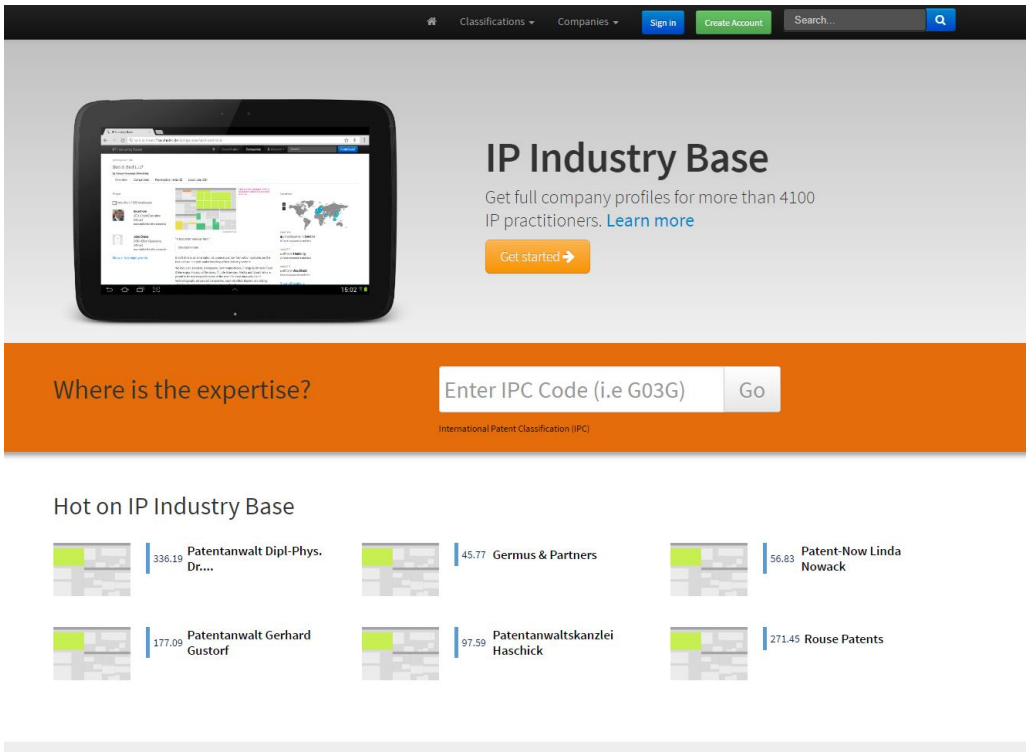


Figure 15 Screenshot of the Opening Page of the IPIB

Within this research, the maintenance is considered as an ongoing phase. The IPSC is permanently checked for incompleteness, inconsistencies or redundancies by collecting IPR service market data. Through the continuous extension of the IPIB, the IPSC is constantly evaluated, updated and therefore properly maintained. If domain incompleteness, inconsistencies, and redundancies are experienced while mapping the IPR service providers with regards to the IPSC to the IPIB, the implementation allows the ontology editor to adjust the classification system. Within the application, the ontology editor is allowed to directly edit the classification system (names, definitions, hierarchical relationships). This assures up to date maintenance of the IPSC on its realization platform. The continuous maintenance is carried out by the IPIB by the ontology editor on the platform. The IPSC is mature because no new categories have been added since 2014. Whenever a new IPR service provider is discovered by a desktop search on IPR service market all the necessary services already exist in the IPSC to add the company to the IPIB since 2014.

6. Interview Results and Further Discussions

6.1. Implications for Industry

The range of IPR services offered on the innovation markets is immense. As a whole, they boost innovation by helping to eliminate the various barriers on the innovation market related to IPR (Tonisson et al., 2016). Their individual impact on innovation and economic growth is diverse and hard to measure directly. Litigation strategy developers and litigation funding service providers are not seen as innovation-friendly businesses. Nevertheless, most of the IPR services are perceived as beneficial for technology producers. A well-organized overview of all possible IPR service providers has so far not been accessible for the experts interviewed.

Throughout the forty-two telephone interviews and the expert group meeting valuable information was collected and stored in updated versions of the IPSC. Expert statements with regards to "how to better organize the IPR market", and "what exactly is the role of IPR service providers for innovation and economic growth" were also collected. Based on expert statements the creation of a taxonomy for all the various IPR services is necessary given all the positive effects that the IPSC could have on innovation and economic growth. A UK interview partner suggested that the IPSC should be updated and validated in order to be useful for the stakeholders after a certain time period when the IPR market has made some significant changes. Most interview partners, however, except one Swedish IPR service provider, were comfortable with the structure and scope of the IPSC. Different points for improvement were discussed throughout the interviews in order to improve the IPSC. All recommendations for IPSC improvement were first validated by the expert group and then implemented.

Almost all the interview partners had in the past or have right now information barriers with regards to IPR service providers. It is not clear who has the real expertise and how many various IPR related service can be outsourced so that the company stays competitive and successful. Many technology company representatives interviewed mentioned that they lack IPR related know-how and specific information about how to handle all the narrow aspects of IPR monetization. Therefore, the IPR service users would

appreciate a catalog of the various IPR services to overcome some of those information barriers.

Most of the interview partners are outsourcing some IPR services to external IPR service providers. IPR service providers help to ease the technology commercialization process if they provide high-quality services. Most technology companies interviewed stated that they would benefit from a quality check or benchmarking tool created for various service providers. It would assist them in outsourcing IPR matters to the best performing service providers.

IPR is a sensitive matter and for many technology firms outsourcing IPR management is related to business risks. Therefore, it is important to trust the service providers. Trust is earned mainly with previous experience, but that has been related to exploitation issues according to the interviews. Similarly, to buying in other kinds of services, competition between the IPR service providers is good. Optimal competition shifts the price and quality of the services provided towards the optimal price and demand setting. The customer is more assured when there is information available about all the services that can be outsourced and additionally a quality check for all the services provided. According to the interviews if a catalog of IPR service providers existed with benchmarking the situation would be much more transparent and efficient.

Using the IPSC as a tool for IPR service quality ranking was strongly suggested by a third of the interview partners. Almost half of the interview partners recommended creating ranking (various ways) for the services listed for the companies mapped in the IPIB. It is important to create quality checks for firms who provide the services listed in the IPSC in a tool if the goal is to maximize the value of IPSC. The interview results furthermore suggested that IPSC could prove to be a useful tool for innovation market developments. *"IPR service providers will better understand where to expand their business"* according to Dr. Ing. Manfred Plischke. *"IPSC used as a tool could lead to harmonization of the IPR industry. It would serve as a platform for IPR service providers to differentiate themselves and to see what's happening on IPR market"* (Craig O´Dell, 2014). *"It is useful for organizations with low IPR culture and knowledge. South-European technology companies do not know more advanced IP services"* (Paolo Foà, 2013). For firms with low IP culture, it could ease the information barrier related to outsourcing IPR services.

6.2. Contributions of the IPSC

It is believed that there is a need for the IPSC because currently, the IPR industry suffers from various problems that could be eased by bringing transparency and common understanding to the market (U St. Gallen and Fraunhofer MOEZ, 2011). This is the main holistic contribution of the IPSC to the innovation market. The contribution to science is a well-defined classification system of IPR service providers that can be used as a building block for various tools where together the IPSC and the platform would address many of the IPR industry problems mentioned above.

IPSC can be used as a standard for understanding and segmenting IPR related services. Standards like International Standard Industrial Classification (ISIC) of All Economic Activities cannot be used because it is too general (i.e. 691 "Legal Activities" is the lowest category in the ISIC, but the highest category in the IPSC). Nonetheless, harmonization between the ISIC, the IPSC, and other classification systems as they emerge might be future work.

Sixteen IPR service providers worldwide have been asked how the IPSC would contribute to the innovation market. The solutions the IPSC could provide were diverse according to the expert interviews. *"Creation of IPSC would not eliminate any of the big IPR market problems, but IPSC as a part of a tool that classifies all the IPR services providers and IPIB as the platform that saves the information on the performance of all the service providers could be helpful"* (Alexander Korenberg, 2014).

Interestingly the classification might have an indirect effect on low patent quality or it might prove to be useful to solve the problem if IPSC would serve as a tool for validating the service providers. *"Services categorization with definitions of all the services linked to service providers would help in the dissemination of knowledge on the many aspects IPR. Integrated into a tool, it can be used to find the competent "real" experts in each set of aspects"* (Henry Suzuki, 2013). The unused IPR problem might ease according to the Indian interview partner (Anant Kataria, 2013). That would be simply due to the chain effect of inventors learning more about various IPR service providers and trusting them with their unused IPR. The role of intermediaries in technology markets and the various effects of intermediaries on IPR market efficiency (Hagiu and Yoffie, 2011) have been debated on policy making roundtables and in related literature as well.

The IPSC would carry greatest the value if the services listed there would be linked to the service providers. Many interview partners stated that small and medium-a sized enterprises (SMEs) will benefit the most from access to IPR related services information. Linking IPR services to corresponding service providers will not help big firms to the extent it will help SMEs because they have an in-house team for IPR and IPR strategy. IPSC integrated into a tool that links services to service providers was stated to help with decision making when making purchasing decisions from inside organization. *"It could help in creating partnerships and find experts/firms to work with. The IPSC would carry the greatest value in the early stage of any IPR transaction. By putting the right parties together for a particular transaction, all parties are on the same page, and understand each other's goals/interest. So an upfront alignment of interest would significantly help a smooth transaction"* (Raj Mendhir, 2013).

"Integrating IPSC into a tool that creates quality check for firms would help to ease the market problems" suggested Raymond Millien (2013). Similarly, other IPR experts stressed the need to connect it to setting standards for IPR service providers. If the IPSC could serve as a part of a tool that creates quality check for firms it would address indirectly many of the above-mentioned issues.

According to the interviews, the best way to apply the IPSC is to create an evaluation tool for IP management. The IPSC can be used as a part of an evaluation tool for operating companies. It can serve as a self-assessment tool. Big industry firms could apply it to check the quality of certain IPR service carried out service by service in the manner suggested below:

Service	**Satisfaction with the execution (from 1[low] to 10[high])**	**Necessity of the service for the company (from 1 to 10)**	**Executed in-house /outsourced**
100 Legal			
110			
…(to)			
660			

Table 18 An IPSC application example for evaluating IPR service execution

Whenever the satisfaction level of a service execution falls below the average score of five it would be suggested to consult IPR specialist service providers to rethink and formulate the strategy regarding this malfunction. An operating company can choose a fragment of the services listed in the IPSC for that exercise or depending on the scope and size of the firm – up to all of them (seventy-two in total). It can also add many other parameters for evaluation based on its needs.

The second application for IPSC could be the evaluation or creation of qualifications for IPR service providers based on the services in the IPSC regionally by authorities. All active IPR service providers should register themselves on an official platform after which their clients could submit controlled/anonymous feedback on the service providers' services offered. That kind of evaluation mechanism would create a quality check for technology companies and would optimize the outsourcing of IPR services.

To sum up, the interview results the IPSC alone will mainly serve as an educational or academic tool that will help to increase IPR awareness and IPR culture. It is useful for organizing IPR industry data that can be thereafter analyzed for better policy making. Additionally, this thesis aims to contribute to a more transparent and single IPR market by aiming to organize the IPR service market in an optimal way. All the above-mentioned functions of the IPSC could benefit the innovation market. However, the IPSC will not provide a single solution to all innovation market problems on its own.

6.3. Limitations of the IPSC and Future Work

The taxonomy presented in this thesis aims to fill a void in the availability of formal taxonomy for the classification of IPR services. The literature on the subject is vastly growing and is considered to be mature, which has allowed for a convergence towards a pragmatic taxonomy of service categories when it comes to the organization of the IPSC. In this work, this practice has been incorporated while adding the necessary rigor in the definitions of the derived IPR service classes. Despite these efforts, limitations exist. Many aspects of the taxonomy are the inescapable result of a personal choice of the experts involved in the evaluation phases among alternative definitions. After conducting forty-two interviews, no new information was collected for improving the IPSC. For further research, it is suggested to carry out an online survey asking the 4,100 IPR service providers, via an online form, to validate the IPSC. The validation is done by

assessing the correctness and coverage of the IPSC based on the service the IPR service providers offer. That could be the first step towards empirical validation of the IPSC by third parties. To date, there exists no data pool of IPR service providers covered in this research. The data on 4,100 IPR service providers was collected for the purpose of this research. Therefore, conducting an empirical validation with a "control group" dataset was impossible. Nevertheless, it is suggested to empirically validate the IPSC as soon as such data pool on IPR services should emerge. A limitation is the lack of empirical validation of the IPR services database due to lack of available data on IPR service providers. The matching was carried out by applying human judgment. Matching of IPR services to IPR service providers was not possible via machine learning[15] approach, which would search for "keywords" in the company descriptions to automatically assign those firms with various services. As the company descriptions were not presented in a homogenous matter on websites, publications or online articles; and mostly not comprehensive enough, artificial intelligence[16] could not be applied for the matching process. It would have simply been too time-consuming to set up a mechanism smart enough to detect real information from false or exaggerated claims. As a result, aspects of the taxonomy matching with IPR service providers are as well the inevitable result of a personal choice. As soon as a dataset similar to IPIB database emerges, empirical validation of the taxonomy is recommended for future work.

This taxonomy is a work in progress that throughout the three years (2012 - 2015) stabilized. The last changes were made to the IPSC in 2015. No new categories were added since 2014, but in 2015 some definitions were refined. In the future, it is recommended to make changes to the IPSC when the IPR service market undergoes some changes. IPSC is limited to the information available to date. The IPR service market is constantly undergoing changes. Therefore, contributions from scholars and IPR service providers along with those from professional oncologists are appreciated and will help to further extend this work.

A suggestion for future work is that the well-defined and categorized service descriptions in the IPSC should be accompanied by an industry-wide adopted model

[15] Machine learning is the subfield of computer science that gives computers the ability to learn while not being explicitly programmed for it (Simon, 2003).

[16] Artificial intelligence (AI) is intelligence exhibited by machines. In computer science, an ideal "intelligent" machine is a flexible rational agent that can analyze and react to its environment and can take actions that maximize its chance of success at some goal (Russell and Norvig, 2003).

service level agreements (SLAs)[17] This institutionalized interfacing has to be supported by seamless workflow management systems[18] integrating all stakeholders in the IPR service production. The IPSC should be integrated into a tool. As a tool that connects IPR services to service providers, it will not be of much help to governments (Joni Sayeler, 2013) but it will help patent owners (Raymond Millien, 2013). It will make it easier to find an appropriate IPR service provider and discover various IPR services. Most of the established stakeholders (multinationals) would find their way through the IPR service world without it. *"Much of the IPR service providers get hired due to recommendations or good connections",* stated Henry Suzuki (2013). He added that *"it will not help people who are not aware of the tool. Information dissemination is the key. IPSC can help generating an overview and understanding of the global IPR service market only if it integrated into a tool".*

Although the realization platform IPIB connects IPR services to services providers it has several limitations – the dataset of IPR service providers is not complete and the IPR service quality cannot be evaluated by the IPR service providers' clients. Additional evidence of success for each service provider is necessary to evaluate the service quality. More data and analytics on realized service contracts, in quantitative as well as qualitative matters, will help to assess the performance level of the service providers in a more objective way. Furthermore, the interfacing between the service providers and the customers has to be standardized in order to help the technology companies to realize better the value of their IPR.

"The IPSC would prove to be the most useful according to half of the experts if the services would be linked to service providers and the service providers would be checked for quality" (Joni Sayeler, 2013) - and *"ranked within their category"* (Raymond Millien, 2013; Henry Suzuki, 2013). According to the Swedish interview partner (Joni Sayeler, 2013) *"that could reduce transaction costs even as you can negotiate more easily and thus save resources when you can back up your "high prices" with high rankings in IPIB for example. Saving time on that means saving resources and could lead the way to*

[17] A service-level agreement (SLA) is a contract between a service provider and its internal or external customers that documents what services the provider will furnish and defines the performance standards the provider is obligated to meet.

[18] A workflow management system provides an infrastructure for the set-up, performance and monitoring of a defined sequence of tasks, arranged as a workflow application.

more efficient markets. It was suggested to use the IPSC for a platform that assesses IPR services". Based on the experts' interviews and the knowledge acquiring phase of this thesis a strong recommendation for future work is the integration of IPSC into a tool that helps to make the IPR market more transparent.

7. Conclusions

Technology markets have matured while the patent has become an asset class. Due to maturation on technology markets, a market for IPR has emerged. The IPR market has several frictions. IPR transactions take place in a highly fragmented marketplace entailing several barriers and challenges. The IPR market is inefficient, not transparent and illiquid. There are several steps to be taken to move towards a more efficient innovation system. The IPR market's legal and regional differences could be solved with government efforts to harmonize the systems, much like what the new EU unitary patent seeks to achieve. With a harmonized system, issues of patent quality and slowness of the patent system can be addressed. Low IPR culture and unused IPR are issues that could solve themselves because they are a direct outcome of the current drawbacks of the IPR market (Tonisson et al., 2016). Increase in patent quality would lead to better IPR valuation methods that would increase the asset class liquidity (U St Gallen and Fraunhofer MOEZ, 2011). Several authors have argued and provided evidence that markets for technology suffer from imperfections, often leading to transaction failures (Caves et al., 1983; Zeckhauser, 1996; Arora et al., 2001; Gans and Stern, 2010; Zhang et al., 2013). Therefore, an organized overview of the IPR market is expected to offer an improvement on the current situation marked by characteristics such as increased market transparency, efficient pricing mechanisms and increased IPR transaction security due to more transparency (U St Gallen and Fraunhofer MOEZ, 2011). In the presence of coordination frictions, and because the market is not transparent and inefficient, middlemen have emerged (Watanabe, 2004). As long as the IPR market remains inefficient the middlemen, namely the IPR service providers, will remain facilitating patent related activities on the IPR market (Hagiu and Yoffie, 2013). Based on previous research (see Tonisson et al., 2016) it is suggested that by increasing the IPR service quality several IPR market frictions could be addressed. So far a comprehensive classification system for all current IPR service providers was missing in research.

This research establishes a well-defined framework for classifying current intellectual property related services – the IPSC. Design science method is applied to make the first step towards well-defined and categorized service descriptions. Towards this goal, this thesis suggests a taxonomy by applying ontology engineering process to structure the

implicit IPR service market. It is a nine-step methodology that helps to assemble the IPSC. From applying the methodology several insights emerged. First and foremost, by matching the IPSC to other similar classifications in research it became evident that no comprehensive taxonomy existed in the research. Previous works (Howells, 2006; Millien, 2013; Hagiu and Yoffie, 2013; Yanagisawa and Guellec, 2009) have developed various typologies for IPR service providers that by definition do not cover a wide range of IPR services. These previously published typologies focus more on recently emerged business models focusing on patent-related transactions. The IPSC is a comprehensive set of all currently available IPR services. Another insight from applying the ontology engineering methodology is the limitations of the evaluation phase. The drawbacks of this methodology are the human assessment steps undertaken in the evaluation phase. Due to no data being available for IPR service providers outside the "Legal Services" category a quantitative assessment was not carried out. Currently, the European Patent Office has a pool of data on patent agents and lawyers (covered in "Legal Services" category in the IPSC) but no further data is available for other categories. The IPSC covers the full set of IPR service providers and therefore cannot be entirely evaluated with only a partial dataset. Acquiring a dataset for the full range of IPR service providers defined in this thesis is a suggestion for further research. As soon as a dataset on all IPR services emerges it should be applied for evaluation purposes.

The IPSC provides a detailed formalization of the current understanding of the IPR service industry. For each set of the services analyzed in this thesis, specialized and advanced tools for collaborative service provision might boost the efficiency in the IPR services market. For future work, the IPSC is suggested to complement industry-wide adopted model service level agreements (SLAs). Additionally, it is suggested that this interfacing between SLAs and the IPSC has to be supported by seamless workflow management systems integrating all stakeholders in the IPR service production.

The semi-structured twenty-six telephone interviews with technology companies and sixteen telephone interviews with IPR managers across Europe confirmed and validated the IPR services concept and structure as a part of the methodology. The interview results suggested that the IPSC integrated as a tool would ease many of the IPR inefficiency and transparency problems. The IPSC is realized and maintained via the IPIB - a database of more than 4,100 IPR service providers. Additionally, the IPIB serves as a tool by linking filed patents, technology producers, and technology fields to more than

4,100 IPR service providers categorized according to the IPSC. The IPIB allows the user to visualize, associate, retrieve and investigate firms based on their services provided in a formal and scalable way. The IPSC integrated as a tool into the IPIB aims to easy the transparency problem on technology markets by integrating real time patenting data into the platform connecting it to IPR service providers categorized according to the classification system developed within this thesis.

The IPSC is the first attempt towards creating a comprehensive list of all currently known IPR service providers on innovation markets. As the IPR market is continuously evolving, there may obviously be other IPR businesses that will use intellectual property as their primary asset than those mentioned within this work. This is the second limitations of this thesis. To date, the IPSC covers all possible IPR services and provides definitions for seventy-two various services. Nevertheless, it is suggested to continuously carry out the maintenance by adding emerging IPR service providers into the taxonomy and if needed adding a new category. Once the IPSC changes it is suggested to adopt the tools built around IPSC according to the changes. To date, based on the ontology engineering process, seventy-two IPR related services can be distinguished on IPR markets. The services are allocated into six main categories and they are the following:

100 Legal Service – services involving legal or law related matters like the issue of patents, preparation of patent filing documents and litigation processes.

200 IP Consulting – advisory services related to various IP aspects providing professional or expert advice in a particular area such as market specifics for a precise industry for patenting, technology and IP roadmaps, and various analyses.

300 Matchmaking and Trading – services related to the arrangement of intellectual property rights related development needs of companies with available resources. Trading involving an exchange of the ownership.

400 IP Portfolio Processing – various services related to the creation of IP portfolios and partial management processes of the portfolio related to creating revenues out of IP.

500 IPR-related Financial Service – resource allocation as well as resource management, acquisition and investment. In other words, finance deals with matters related to money and the markets.

600 IP-related Communication Service – the collective communication outlets or tools that are used to store and deliver information on IPR related topics or data, like publications, journals, blogs and educational materials. Additionally, the correspondents of IPR related issues like unions and IP interest groups.

The contribution to science is a well-defined classification system of IPR service providers that can be used as a building block for various tools. The IPSC integrated into a tool would address many of the IPR industry problems mentioned above according to the interviews carried out. It could be the first step towards creating a qualification standard for various services or serve as a self-assessment tool for operating companies with regards to IPR strategy. The categorization of IPR service providers with a clear definition for each service can make outsourcing of IPR related services more efficient. The IPSC could help to set up a quality benchmarking system for any offered service which would hopefully eliminate poor quality service providers from the market. That would lead to an increase in IPR services which would help to ease many IPR market current problems.

References

Aldrich, H. E., von Glinow, M. A. (1992). Business start-ups: the HRM imperative. In: Birley, S., MacMillan, I.C. (Eds.), International Perspectives on Entrepreneurial Research. North-Holland, New York, pp. 233–253.

Altitude Capital Partners. (2007). Altitude Capital Partners Completes First-Ever Dual Private Equity Investment/Intellectual Property Investment in Deep Nines, Inc. [Press Release]. Retrieved from http://www.altitudecp.com/pdf/DeepNines %20final.pdf

Arnold, P. (2015). Semantic Enrichment of Ontology Mappings. Dissertation Von der Fakultät für Mathematik und Informatik der Universität Leipzig.

Arora, A., Fosfuri, A., Gambardella, A. (2001). Markets for Technology: The Economics of Innovation and Corporate Strategy. MIT Press, Cambridge, MA.

Bar-Gill, O., Parchomovsky, Gideon. (2003). The Value of Giving Away Secrets. Faculty Scholarship. Paper 27. http://scholarship.law.upenn.edu/faculty_scholarship/2

Barron, R. J. (2008). Venture Funded IP Litigation Funds (VFLP-IP): What, Who, How. Presentation at Wisconsin Intellectual Property Law Association meeting, Milwaukee, WI.

Batterink, M. H., Wubben, E. F. M., Klerkx, L., Omta, S. (2010). Orchestrating innovation networks: The case of innovation brokers in the agrifood sector. Entrepreneurship & Regional Development, 22(1): 47-76.

Benassi, M., Minin, A. (2009). Playing in between: patent brokers in markets for technology. R&D Management, 39(1), 68-86.

Bessant, J., Rush, H. (1995). Building bridges for innovation: the role of consultants in technology transfer. Research Policy, 24(1), 97-114.

Bessen, J., Meurer, M. J. (2009). Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk. Princeton, NJ: Princeton University Press.

Birkenmeier, B. (2003). Externe Technologie-Verwertung: Eine komplexe Aufgabe des Integrierten Technologie-Managements. http://dx.doi.org/10.3929/ethz-a-004620337

Blind, K., Edler, J., Frietsch, R., Schmoch, U. (2006). Motives to patent: Empirical evidence from Germany?", In: Research Policy, 35(5), pp. 655-672.

Bodner, R. C., Song, F. (1996). Knowledge-based approaches to query expansion in in-formation retrieval. In G. McCalla (Ed.), Advances in Artificial Intelligence (146-158). New York: Springer-Verlag.

Bramson, R. S. (2000). Mining the Patent Portfolio for Licensing Opportunities and Revenues. les Nouvelles – Journal of the Licensing Executives Society, 35(3), 109-115.

Braun, D. (1993). Who governs intermediary agencies? Principal-agent relations in research policy-making. Journal of Public Policy 13, 135–162.

Brenner, S. (2009). Optimal formation rules for patent pools. Economic Theory, 40(3), 373–388.

Callon, M. (1994). Is science a public good? Science, Technology and Human Values 19, 395–424.

Cash, D. W. (2001). In order to aid in diffusion useful and practical information: agricultural extension and boundary organizations. Science, Technology and Human Values 26, 431–453.

Caves, R., Crookell, H., Killing, J. (1983). The imperfect market for technology licenses Oxf. Bull. Econ. Stat., 45 pp. 249–267.

Chandrasekaran, B., Josephson, J. R., Benjamins, V. R. (1999). What are ontologies, and why do we need them? IEEE Intelligent Systems, 14(1), 20-26. http://dx.doi.org/10.1109/5254.747902

Chatterjee, D. (1996). Accessing external sources of technology. Research Technology Management, 39 (2), 48–56.

Chesbrough, H. (2006). Open Business Models: How to Thrive in the New Innovation Landscape. Boston, MA: Harvard Business School Press.

Clark, J., Piccolo, J., Stanton, B., Tyson, K. (2000). Patent Pools: A Solution to the Problem of Access in Biotechnology Patents? United States Patent and Trademark Office (USPTO). Retrieved from http://www.uspto.gov/web/offices/pac/dapp/opla/patentpool.pdf

Czarnitski, D., Spielkamp, A. (2000). Business services in Germany: bridges for innovation. ZEW Discussion Paper No. 00-52. Retrieved from ftp://ftp.zew.de/pub/zew-docs/dp/dp0052.pdf

Czarnitzki, D., Licht, G., Rammer, C., Spielkamp, A. (2001). Rolle und Bedeutung von Intermediären im Wissens- und Technologietransfer. ifo Schnelldienst, 54(4), 40-49.

Di Maio, P. (2009). Toward Just Enough Ontology Engineering. Business Intelligence, Vol. 9, No, 1–18.

DRI Capital. (2008). DRI Capital Launches Structured Finance Fund [Press Release]. Retrieved from www.dricapital.com/show_info.php?page_id=31

Ewing, T. (2011). Indirect Exploitation of Intellectual Property Rights by Corporations and Investors: IP Privateering & Modern Letters of Marque & Reprisal. Chalmers University of Technology.

Ewing, T., Feldman, R. (2012). The Giants Among Us. Stanford Technology Law Review. Retrieved from http://repository.uchastings.edu/faculty_scholarship/158

Fensel, D. (2004). Ontologies: A Silver Bullet for Knowledge Management and Electronic Commerce. Berlin: Springer-Verlag. http://dx.doi.org/ 10.1007/978-3-662-09083-1

Fernández, M., Gómez-Pérez, A., Sierra, A. P., Sierra., J. P. (1999). Building a Chemical Ontology Using METHONTOLOGY and the Ontology Design Environment. IEEE Expert (Intelligent Systems and Their Applications), 14(1):37–46.

Fernández-López, M., Gómez-Pérez, A., Juristo, N. (1997). In Proceedings of the Ontological Engineering AAAI-97 Spring Symposium Series (24-26). Palo Alto, CA: Stanford University, EEUU. Retrieved from http://oa.upm.es/5484/

Fox, M. S., Gruninger, M. (1998). Enterprise Modelling. AI Magazine, 19(3), 109-121. Palo Alto, CA: AAAI Press.

FTC, Federal Trade Commission. (2008). Public Hearings Concerning the Evolving Intellectual Property Marketplace. Retrieved from www.ftc.gov/os/2008/11/P093900ipwkspfrn.pdf

Fu, S., Perkins, D. (1995). Technology licensors and licensees: who they are, what resources they employ and how they feel. International Journal of Technology Management, 10(7), 907-920.

Gallini, N. (2011). Private Agreements for Coordinating Patent Rights: The Case of Patent Pools. IEL Working Papers 5, Institute of Public Policy and Public Choice – POLIS. Retrieved from http://polis.unipmn.it/pubbl/RePEc/uca/ucaiel/iel005.pdf

Gans, J., Stern, S. (2010). Is there a market for ideas? Ind. Corp. Change, 19 pp. 805–837.

Garshol, L. M. (2004). Metadata? Thesauri? Taxonomies? Topic Maps! Making sense of all. Journal of Information Science, 30(4), 378-391.

Gómez-Pérez, A., Fernandez-Lopez, M., Corcho, O. (2004). Ontological Engineering with Examples from the Areas of Knowledge Management, e-Commerce and the Semantic Web. First Edition Series: Advanced Information and Knowledge Processing 1st ed. 2004. 2nd printing, 2004, XII, 403 p. 159 illus., ISBN: 978-1-85233-551-9.

Gómez-Pérez, A., Juristo, N., Pazos, J. (1995). Evaluation and Assessment of Knowledge Sharing Technology. In Mars, N., (Ed.), Towards Very Large Knowledge Bases (289-296). Amsterdam: IOS Press.

Gómez-Pérez, A., Mariano, F., de Vicente, A. J. (1996). Towards a Method to Conceptualize Domain Ontologies. In Proceedings of ECAI96's Workshop on Ontological Engineering (41–52).

Granstrand, O. (2000). The shift towards intellectual capitalism - the role of infocom technologies. Research Policy, 29(9), 1061-1080.

Gray, C. (2008). A New Era in IP Licensing: The Unit License Right Program. The Licensing Journal, 28(10), 27-32. New York: Aspen Publishers.

Gruber, T. R. (1995). Toward principles for the design of ontologies used for knowledge sharing. International Journal of Human-Computer Studies, 43(5), 907–928.

Gruber, T. R. (1991). The role of common ontology in achieving sharable, reusable knowledge bases. In Allen, J., Fikes, R., Sandewall, E., (Eds.), Proceedings of the 2nd International Conference on Principles of Knowledge Representation and Reasoning (601–602). San Mateo, CA: Morgan Kaufmann Publishers.

Guarino, N. (1998). Formal Ontology in Information Systems: Proceedings of FOIS'98, Trento, Italy. Amsterdam: IOS Press.

Guarino, N., Masolo, C., Vetere, G. (1999). Ontoseek: Content-based access to the web. IEEE Intelligent Systems, 14(3), 70–80.

Guston, D. H. (1996). Principal-agent theory and the structure of science policy. Science and Public Policy 23, 229–240.

Hagiu, A., Yoffie, D. (2011). Intermediaries for the IP market. Working paper, Harvard Business School. Retrieved from http://www.hbs.edu/faculty/Publication%20Files/12-023_0e95cdce-abbf-46ea-b8cb-15a3ebb054ed.pdf

Hagiu, A., Yoffie, D. (2013). The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-Aggregators. Journal of Economic Perspectives, 27(1), 45-66. Nashville, TN: American Economic Association.

Hall, B., Helmers, C. (2010). The role of patent protection in (clean/green) technology transfer. Santa Clara High Technology Law Journal, 26(4), 487-532. Retrieved from http://digitalcommons.law.scu.edu/chtlj/vol26/iss4/1/

Hanel, P. (2006). Intellectual property rights business management practices: A survey of the literature. Technovation, 26(8), 895-931.

Hansell, S. (2009). Trolling for Patents to Fight Patent Trolls. The New York Times. New York: The New York Times Company.

Hargadon, A. (1998). Firms as knowledge brokers: lessons in pursuing continuous innovation. California Management Review 40, 209–227.

Hargadon, A., Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. Administrative Science Quarterly, 42, 718–749.

Heflin, J., Hendler, J. (2000). Searching the web with SHOE. In AAAI Technical Report WS-00-01. Palo Alto, CA: AAAI Press. Retrieved from https://www.aaai.org/Papers/Workshops/2000/WS-00-01/WS00-01-007.pdf

Howells, J. (1999). Research and technology outsourcing. Technology Analysis & Strategic Management 11, 591–603.

Howells, J. (2006). Intermediation and the role of intermediaries in innovation, Research Policy. Vol 35, pp 715-728.

INCJ, Innovation Network Corporation of Japan. (2009). A new initiative to drive next-generation businesses [Press Release].

IV, Intellectual Ventures. (2009). Invention Company Intellectual Ventures Opens Bellevue Laboratory [Press Release]. Retrieved from: http://www.intellectualventures.com/news/press-releases/intellectual-ventures-opens-bellevue-laboratory/

Jeitschko, T. D., Zhang, N. (2012). Adverse Effects of Patent Pooling on Product Development and Commercialization. Economic Analysis Group Discussion Paper. Retrieved from http://www.justice.gov/atr/public/eag/283557.pdf

JPO, Japan Patent Office. (2008b). Annual Report 2008. Tokyo: JPO.

JPO, Japan Patent Office. (2008a). New Intellectual Property Policy for Pro-Innovation: Intellectual Property System as Global Infrastructure. Retrieved from www.jpo.go.jp/torikumi_e/puresu_e/pdf/press_new_intellectual_property_policy/report_e.pdf

Khan, L., McLeod, D. (2000). Effective retrieval of audio information from annotated text using ontologies. In Simoff, S. J., & Zaiane, O. R., (Eds.), Workshop on Multimedia Data Mining MDM/KDD'2000 (37-45). Edmonton: University of Alberta.

Klerkx, L., Hall, A., Leeuwis, C. (2009). Strengthening agricultural innovation capacity: are innovation brokers the answer? International Journal of Agricultural Resources, Governance and Ecology, 8(5): 409-438.

Klerkx, L., Leeuwis, C. (2008). Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries. Food Policy, 33(3): 260-276.

Kowalski, P. S. (2015). Golden Rice, Open Innovation, and Sustainable Global Food Security. Industrial Biotechnology, 11(2), 84-90. http://dx.doi.org/10.1089/ind.2015.1506

Krattiger, A. F. (2004). Financing the Bioindustry and Facilitating Biotechnology Transfer. IP Strategy Today, 8.

Lamoreaux, N., Sokoloff, K. (2002). Intermediaries in the U.S. Market for Technology, 1870-1920. NBER Working Papers 9017. Cambridge, MA: National Bureau of Economic Research, Inc.

Lampe, R., Moser, P. (2010). Do Patent Pools Encourage Innovation? Evidence from the 19th-Century Sewing-Machine Industry. The Journal of Economic History, 70, 898-920. http://dx.doi.org/10.1017/S0022050710000768

Lenat, D. B., Guha, R. V. (1990). Building large knowledge-based systems: Representation and inference in the cyc project. Boston, AddisonWesley.

Lerner, J., Strojwas, M., Tirole, J. (2005). The Design of Patent Pools: The Determinants of Licensing Rules. IDEI Working Papers 187., Toulouse: Institut d'Économie Industrielle (IDEI).

Lichtenthaler, U., Ernst, H. (2008). Intermediary services in the markets for technology: Organizational antecedents and performance consequences. Organization Studies, 29(7), 1003-1035.

Lien, A. P. (1979). Acquiring and Selling Technology: The Role of the Middleman. Research Management, 22(3), 29-31.

Lipfert, S., Ostler, J. (2009). Fonds und Auktionen: Neue Formen der Patentverwertung. Gewerbliche Schutzrechte im Innovationsprozess, 85–106. Wiesbaden: DUV.

Lo, Y., Liu, W., Wen, C. (2010). The value added capability of innovation intermediaries in technology transaction markets. In Technology Management for Global Economic Growth (PICMET) Proceedings of PICMET '10 (1-6). Portland, OR: PICMET.

Lopez, M. F., Gomez-Perez, A., Sierra, J. P., Sierra, A. P. (1999). Building a Chemical Ontology Using Methontology and the Ontology Design Environment. IEEE Intelligent Systems, 14(1), 36-46. http://dx.doi.org/10.1109/5254.747904

Lynn, L. H., Reddy, N. M., Aram, J. D. (1996). Linking technology and institutions: the innovation community framework. Research Policy, 25, 91–106.

Mantel, S. J., Rosegger, G. (1987). The role of third-parties in the diffusion of innovations: a survey. In Rothwell, R., & Bessant, J., (Eds.), Innovation: Adaptation and Growth (123–134). Amsterdam: Elsevier.

Masters, A. (2005). "Middlemen in Search Equilibrium" Discussion Papers 04-11, University at Albany, SUNY.

Mayring, P. (2000). Qualitative Inhaltsanalyse. Grundlagen und Techniken (7th ed.). Weinheim: Deutscher Studien Verlag.

McEvily, B., Zaheer, A. (1999). Bridging ties: a source of firm heterogeneity in competitive capabilities. Strategic Management Journal, 20(12), 1133–1156.

McGuiness, D. L. (1998). Ontological issues for knowledge-enhanced search. In Formal Ontology in Information System: Proceedings of FOIS'98. Amsterdam: IOS Press.

Millar, C. C. J. M. Choi, C. J. (2003). Advertising and knowledge intermediaries: managing the ethical challenges of intangibles. Journal of Business Ethics 48, 267–277.

Millien, R., Laurie, R. (2007). A Summary of Established & Emerging IP Business Models. Paper presented at The Sedona Conference, Phoenix, AZ.

Millien, R., Laurie, R. (2008). Meet the middlemen. Intellectual Asset Management (IAM) Magazine, 28, February/March 2008. London: Globe White Page Ltd.

Millien, R. (2013, January 28th). Landscape 2013: Who are the Players in the IP Marketplace? IPWatchdog. Retrieved from http://www.ipwatchdog.com/2013/01/23/ip-landscape/id=33356/

Mittag, H. (1985). Technologiemarketing - Die Vermarktung von industriellem Wissen unter besonderer Berücksichtigung des Einsatzes von Lizenzen. Bochum: Studienverlag Dr. N. Brockmeyer.

Monk, A. (2009). The Emerging Market for Intellectual Property: Drivers, Restrainers, and Implications. Journal of Economic Geography, 9(4), 469-491. http://dx.doi.org/10.1093/jeg/lbp003

Neches, R., Fikes, R., Finin, T., Gruber, T., Patil, R., Senator, T., Swartout, W. R. (1991). Enabling technology for knowledge sharing. AI Magazine, 12(3), 36–56.

Nemutanzhela, P., Iyamu, T. (2011). The impact of competitive intelligence on products and services innovation in organization. International Journal of Advanced Computer Science and Applications (IJACSA), 2(11), 39-44.

O'Leary, D. (1998). Using AI in knowledge management: Knowledge bases and ontologies. IEEE Intelligent Systems, 13(3), 34–39.

OECD (2006a). OECD Science, Technology and Industry Outlook 2006. Paris: OECD Publishing.

OECD (2006b). Guidelines for the Licensing of Genetic Inventions [Policy guideline]. Retrieved from http://www.oecd.org/sti/biotechnology/licensing.

Palmisano, S. J. (2006). The Globally Integrated Enterprise. Foreign Affairs, 85(3), 127-136. New York/Washington D.C.: Council on Foreign Relations.

Pâslaru-Bontaş, E. (2007). Doctorate. Freie Univerität Berlin, Berlin, checked on 5th October 2016.

Pilorget, L. (1993). Innovation consultancy services in the European community. International Journal of Technology Management 8, 687–696.

Pollard, D. (2006). Innovation and Technology Transfer Intermediaries: A Systemic International Study. In Beyerlein, M. M., Beyerlein, S. T., Kennedy, F. A. (Eds.), Innovation through Collaboration, Advances in Interdisciplinary Studies of Work Teams, 12 (137-174). Bingley, UK: Emerald Group Publishing Limited.

Poltorak, A. (2006, May 12th). On "Patent Trolls" and Injunctive Relief. [Blog Post]. Retrieved on 28th August 2015 from http://ipfrontline.com/2006/05/on-patent-trolls-and-injunctive-relief/

Popp, A. (2000). Swamped in information but starved of data: information and intermediaries in clothing supply chains. Supply Chain Management, 5, 151–161.

Prilop, M., Tonisson, L., Maicher, L. (2012). Service profiling - a method for data-driven competitive intelligence in service industries Smart Services and Service Science. Proceedings of the 4th International Symposium on Services Science, Leipzig (Germany). Leipziger Beiträge zur Informatik, 36. Leipzig: LIV/InfAI. ISBN: 978-3-941608-23-8.

Provan, K. G., Human, S. E. (1999). Organizational learning and the role of the network broker in small-firm manufacturing networks. In Grandori, A. (Ed.), Interfirm Networks: Organization and Industrial Competitiveness (185–207). London: Routledge.

Rothberg, N. H., Erickson, G. S. (2004). From knowledge to intelligence: creating competitive advantage in the next economy. London: Sage Publications.

Russell, S. J., Norvig, P. (2003). Artificial Intelligence: A Modern Approach (2nd ed.), Upper Saddle River, New Jersey: Prentice Hall, ISBN 0-13-790395-2.

Sapsed, J., Grantham, A., DeFillippi, R. (2007). A bridge over troubled waters: bridging organisations and entrepreneurial opportunities in emerging sectors. Research Policy, n. 36, pp. 1314-1334.

Sawyer, D. C. (2002). Smart Services: Competitive Information Strategies, Solutions, and Success Stories for Service Businesses. Medford, NJ: Cyberage Books.

Seaton, R. A. F., Cordey-Hayes, M. (1993). The development and application of interactive models of industrial technology transfer. Technovation 13, 45–53.

Seyfer, J. (2007, June 28th). Private Equity Helps Fuel IP Wars [Journal Article]. Law.com. Retrieved from http://www.altitudecp.com/pdf/June%2028,%202007%20Private%20Equity%20Helps%20Fuel%20IP%20Wars%20(American%20Lawyer%20Media's%20Law.com).pdf

Shapiro, C. (2001). Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting. Innovation Policy and the Economy, 1, 119-150. Cambridge, MA: MIT Press.

Shohert, S., Prevezer, M. (1996). UK biotechnology: institutional linkages, technology transfer and the role of intermediaries. R&D Management 26, 283–298.

Sicilia, M-Á. (2006). Metadata, semantics, and ontology: providing meaning to information resources', Int. J. Metadata, Semantics and Ontologies, Vol. 1, No. 1, pp.83–86.

Simon, Phil. (2013). Too Big to Ignore: The Business Case for Big Data. Wiley. p. 89. ISBN 978-1-118-63817-0.

Sintek, M., Tschaitschian, B., Abecker, A., Bernardi, A., Muller H. J. (2000). Using ontologies for advanced information access. In Domingue, J. (Ed.), PAKeM 2000, The Third International Conference and Exhibition on The Practical Application of Knowledge Management.

Solomon, D., Marcowitz-Bitton, M. (2014). Intellectual Property Securitization. Available at SSRN: http://ssrn.com/abstract=2462216

Sowa, J. F. (2000). Knowledge representation: logical philosophical, and computational foundations. Pacific Grove: Brooks Cole Publishing Co.

Spencer, Tom. (2013). MECE Framework. Consulting Frameworks (TomSpencer.com). Retrieved from http://www.spencertom.com/2013/01/30/mece-framework/#.WCnE-vnhBaQ

Staab, S., Angele, J., Decker, S., Erdmann, M., Hotho, A., Maedche, A., Schnurr, H. P., Studer, R., Sure, Y. (2000). AI for the web - ontology-based community web portals. IAAI00-015, 1034–1039. Palo Alto, CA: AAAI. Retrieved from https://www.aaai.org/Papers/IAAI/2000/IAAI00-015.pdf

Stankiewicz, R. (1995). The role of the science and technology infrastructure in the development and diffusion of industrial automation in Sweden. In Carlsson, B. (Ed.), Technological Systems and Economic Performance: The Case of Factory Automation, (165–210). Dordrecht: Springer Verlag.

Studer, R., Benjamins, V. R., Fensel, D. (1998). Knowledge engineering: principles and methods. Data and Knowledge Engineering, 25(1), 161–197.

Sure, Y., Staab, S., Studer, R. (2003). On-To-Knowledge methodology. In: Staab S., Studer R. (eds.) Handbook on Ontologies, chapter 6, pp. 117–132. Springer-Verlag, Berlin Heidelberg New York.

Szogs, A., Chaminade, C., Azatyan, R. (2008). "Building absorptive capacity in less developed countries. The case of Tanzania". CIRCLE Electronic working papers 2008/08.

The Economist. (2009, September 19th). A market for ideas: A pioneering "innovation marketplace" is making steady progress. London: The Economist Newspaper Ltd.

Tietze, F. (2010). A Typology of Technology Market Intermediaries. Technology and Innovations Management Working Paper, No. 60. Cambridge: Institute of Manufacturing, University of Cambridge.

Tietze, F., Barreto, A. (2007). Intellectual Property Monetization: The Market and its Business Models. Hamburg: Institute for Technology and Innovation Management, Hamburg University of Technology.

Tietze, F., Herstatt, C. (2010). Technology Market Intermediaries and Innovation. Paper presented at DRUID Summer Conference, Imperial College, London.

Tonisson, L., Maicher, L. (2012). Patents, their importance and valuation methods. Working Paper 3/2012. Fraunhofer Center for International Management and Knowledge Economy. Leipzig.

Tonisson, L., Millien, R., Maicher, L. (2016). Shortcomings on the Market for Intellectual Property. Working Paper 1/2016. Fraunhofer Center for International Management and Knowledge Economy. Leipzig.

Tsitoura, N., Stephens, D. (2012). Development and evaluation of a framework to explain causes of competitive intelligence failures. Information Research, 17(2), 9.

Turpin, T., Garrett-Jones, S., Rankin, N. (1996). Bricoleurs and boundary riders: managing basic research and innovation knowledge networks. R&D Management 26, 267–282.

Ullrich, M., Maier, A., Angele, J. (2003). Taxonomie, Thesaurus, Topic Map, Ontologie - ein Vergleich. Ontoprise White Paper, Karlsruhe http://www.ullri.ch/ullri_ch/download/Ontologien/ttto13.pdf, 22.02.2005.

University of St. Gallen, Fraunhofer MOEZ. (2011). Creating a financial marketplace for IPR in Europe. Final Report for European Commission to EU Tender No 3/PP/ENT/CIP/10/A/NO2S003. Brussels: European Commission.

Uschold, M. (1998). Knowledge level modelling: concepts and terminology. The Knowledge Engineering Review, 13(1), 5-29.

Uschold, M., Gruninger, M. (1996). Ontologies: Principles, Methods and Applications. The Knowledge Engineering Review, 11(2), 93-163.

Uschold, M., King, M. (1995). Towards a Methodology for Building Ontologies. Proceedings Workshop on Basic Ontological Issues in Knowledge Sharing, IJCAI95, 1995.

Van der Meulen, B., Rip, A. (1998). Mediation in the Dutch science system. Research Policy 27, 757–769.

Van Heijst, G., Schreiber, A. T., Wielinga, B. J. (1997). Using explicit ontologies in KBS development. International Journal of Human-Computer Studies, 46(2), 183–292.

Van Hoorebeek, M., Onzivu, W. (2010). The Eco-Patent Commons and Environmental Technology Transfer: Implications for Efforts to Tackle Climate Change. Carbon and Climate Review, 4(1), 17.

Wand, Y., Weber, R. (2002). Research Commentary: Information Systems and Conceptual Modelling - A Research Agenda, Information Systems Research (13), pp. 363-377.

Watanabe, M. (2004). Middlemen: The Visible Market Makers. Universidad Carlos III de Madrid, Working Paper 06-10. Online available at: http://papers.ssrn.com/sol3/ papers.cfm?abstract_id=894866

Watkins, D., Horley, G. (1986). Transferring technology from large to small firms: the role of intermediaries. In: Webb, T., Quince, T., Watkins, D. (Eds.), Small Business Research. Gower, Aldershot, pp. 215–251.

Watson, R. (2008). A Problem Shared Is a Problem Solved. Fast Company. Retrieved from https://www.fastcompany.com/918957/problem-shared-problem-solved

Weick, K. E. (1995). Sensemaking in organizations. Thousand Oaks, CA: Sage.

Winch, G. M., Courtney, R. (2007). The organization of innovation brokers: An international review. Technology analysis & strategic management, 19(6): 747-763.

Wolpert, J. D. (2002). Breaking out of the innovation box. In: Harvard Business Review August, pp. 77–83.

Yanagisawa, T., Guellec, D. (2009). The Emerging Patent Marketplace. OECD Science, Technology and Industry Working Paper, 2009/9. Paris: OECD Publishing. Retrieved from http://www.oecd.org/sti/sci-tech/44335523.pdf

Yurkerwich, D. (2008). Patent sales and the IP business plan. Licensing in the Boardroom. London: Globe White Page Ltd.

Zeckhauser, R. (1996). The challenge of contracting for technological information Proc. National Academy of Science U.S.A., 93 pp. 12743–12748.

Zhang, L., Agrawal, A., Cockburn, I. (2013). Deals Not Done: Sources of Failure in the Market for Ideas Mimeo, University of Toronto.

Zhang, X. M., Liu, Q., Wang, H. Q. (2012). Ontologies for intellectual property rights protection. Expert Systems with Applications, 39(1), 1388-1400.

List of experts interviewed and the date of interview

Cited in the text: full name, year of the interview, eg. (Akos Sule, 2013).

1. Akos Sule, 30.11.2013
2. Alan South, 31.05.2012
3. Alexander Korenberg, 15.01.2014
4. Alexey Matveev, 15.05.2012
5. Anant Kataria, 14.01.2014
6. Andreas Härbele, 17.08.2012
7. Craig O'Dell, 14.01.2014
8. Dan Ninan, 18.05.2012
9. Vincent Guenebaut, 30.05.2012
10. Emma Gobson, 16.08.2012
11. Fabien Michel, 13.06.2012
12. Gary Ling, 04.10.2013
13. Henry Suzuki, 22.11.2013
14. Ilaria Rosso, 17.05.2012
15. Jens Muttersbach, 14.08.2012
16. Jeremy Ellison, 31.05.2012
17. John O'Regan, 16.08.2012
18. Jonas Severin Frank, 22.11.2013
19. Jonathan Short, 18.05.2012
20. Joni Sayeler, 04.12.2013
21. Josep Maria Pujals, 05.12.2013
22. Lars Mach, 22.08.2012
23. Manfred Plischke, 03.12.2013
24. Marco van der Hijen / Marieke Andringa, 21.05.2012
25. Michele Pennese, 16.05.2012
26. Mikk Putk, 29.08.2013
27. Moritz von Plate, 18.05.2012
28. Naomi Aptowitzer, 11.06.2012
29. Paolo Foà, 05.12.2013
30. Per Brynildsen, 24.08.2012
31. Per Olofsson, 14.06.2012
32. Philipp Degenhardt, 13.06.2012
33. Raj Mendhir, 03.12.2013
34. Raymond Millien, 02.12.2013
35. Shaun Fitzgerald, 14.05.2012
36. Steve Jenkins, 16.08.2012
37. Taavi Raidma, 30.08.2013
38. Thomas Almesjö, 11.06.2012
39. Thomas Helbling, 24.08.2012
40. Thomas Leiber, 28.08.2102
41. Wilco van Hoogstraeten, 28.08.2012
42. Xiao-dong Li, 15.01.2014

Appendices

Appendix 1

Fraunhofer
MOEZ

IPST – a classification of Intellectual Property Related Services

State of the Art

IP markets have witnessed great developments during the last two decades. Nevertheless, research on IP-related service markets remains minimal. The intermediary concept is already extensively discussed in the context of IP transactions by Mittag (1985), Fu and Perkins (1995), Pollard (2006) and Tietze and Barreto (2007) who state that intellectual property intermediaries either support the whole intellectual property exchange process (e.g. auctions, intellectual property exchanges, matchmaking) or provide patent owners with particular services in certain stages of the transaction process (e.g. intellectual property valuation or drafting). The current role of these service providers is quite diverse (U St. Gallen 2011). More recent works of practitioners have looked further into the business models of IP market intermediaries (Millien and Laurie 2007, 2008). But an overall and detailed categorization of these services is missing.

IPST - classification for all IP related services. This IP service taxonomy is constructed by collecting IP service market data, by conducting industry interviews and studying existing literature. The taxonomy defines and divides more than 80 different services present on current IP service markets into 6 main categories.

The top-categories of the IPST (Intellectual Property Service Taxonomy)

The IPST defines the following six top-categories of IP-related services:

100 IP-related Finance Services – defined as services involving IP related resource allocation (resource management, acquisition and investment with respect to intellectual property).

200 Matchmaking & Trading – defined as services that ensure that IP development needs meet available resources. Trading related services include IP brokerage, IP scouting, as well as IP auctions and exchanges.

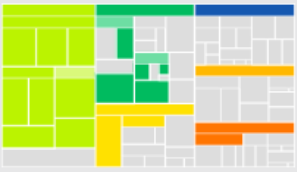
300 Patent and Portfolio Processing – defined as operational services involving IP portfolio management, - aggregation and - augmentation of patents owned (or controlled) by a single entity (or group of entities).

400 Legal Services – defined as services involving legal or law related matters like issue of patents. It includes IP protection, - contracting and - litigation.

500 IP Consultation – defined as advisory services related to intellectual property. It includes IP portfolio analysis, strategy development, IP driven M&A support, fighting infringements, counterfeiting & piracy as well as internationalization support.

600 Media & People – defined as publications, journals, blogs and education programs focused on IP related topics. It includes IP software, databases as well as IP-centric human resource services.

The latest version of the IPST is always available at http://ipib.cl.moez.fraunhofer.de/ipst



Methodology

In order to find an initial set of services for the IPST an extensive desktop research was accomplished by examining media and literature and by investigating practitioners' point-of-view. In a second step a database of more than 600 IP service companies was established. For each of the companies the service portfolio was defined by a set of service descriptions from the IPST. Within this process new types of services emerged and the overall structure of the classification was accomplished. Finally industry companies were asked to confirm and agree upon the final IPST in 25 semi-structured telephone interviews. As result 6 top-categories of services have been defined (see the box) which are divided into more than 80 subcategories. IPST is under continuous revision because we constantly observe the industry developments and translate new trends into new categories.

How to use IPST?

The IPST is meant for developing a deeper understanding about the current IP-related business models and market developments. The IPST should be used to categorize, analyze and compare IP service providers.

The IPST is currently used in the IP Industry Base (IPIB)[1]. This is a continuously extended database that today has more than 600 international IP service providers, developed by the Fraunhofer MOEZ. The IPIB uses the IPST to define a service profile for each service provider (Prilop et al. 2012). This profile is the set of all services which are externally provided by a given company. As depicted in figure 1 the profile is currently used for visualizations, but also for improved searches or the automatic calculation of similar companies.

The IPIB has shown that besides some popular services like IP patent search (executed by 212 companies) a wide variety of service is provided very infrequently, like IP litigation insurances for inventors (currently 1 company in the sample).

In the future, the IPIB will continuously be updated. The continuous updates of the IPIB ensures that the information available in the database will always provide possibilities for accurate and timely analysis of the IP service industry.

[1] http://ipib.cl.moez.fraunhofer.de/

References

Millien, R., Laurie R., (2007), "A Summary of Established & Emerging IP Business Models", The Sedona Conference, Phoenix, AZ.

Millien, R., Laurie R., (2008), "Meet the middlemen", Intellectual Asset Management (IAM) Magazine, February/March 2008, issue 28, Globe White Page Ltd.

Mittag, H., (1985), "Technologiemarketing - Die Vermarktung von industriellem Wissen unter besonderer Berücksichtigung des Einsatzes von Lizenzen Bochum", Studienverlag Dr. N. Brockmeyer

Tietze, F., Barreto A., (2007), "Intellectual Property Monetization: The Market and its Business Models", Institute for Technology and Innovation Management, Hamburg University of Technology.

U St. Gallen; Fraunhofer MOEZ, (2012), "Creating a financial marketplace for IPR in Europe", Final Report for European Commission to EU Tender No 3/PP/ENT/CIP/10/A/NO2S003

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Appendix 2

European Commission

5th International Conference on Future-Oriented Technology Analysis (FTA)
Engage today to shape tomorrow
Brussels, 27-28 November 2014

Intelligence on the IP Service Industry as innovative input for FTA

Predicting future market movements with IPIB data

IP Industry Base (IPIB) - an indicator for market shifts

In the knowledge based economy, patents are changing from purely exclusionary instruments into intangible assets that play a part in business strategy and have monetary value as transactional goods (Monk, 2009). Technology developers increasingly need assistance with intellectual property (IP) related matters, and the demand is met by the young and growing industry of IP service providers all over the world.

IPIB - a tool for FTA approaches

With the IP Industry Base (IPIB, Figure 1, Table 1), we have designed and implemented an intelligence tool for the systematic collection, monitoring and assessment of over 2100 companies active in the global IP industry. The accumulated data provides the basis for future oriented-technology analysis (FTA) approaches, as the IP service industry is a good reflection of market shifts and shocks worldwide.

The development of the global IP service industry from 1970 until 2012 is presented in Figure 2, and direct links can be established between shifts in the registration number of new IP service companies and worldwide economic developments

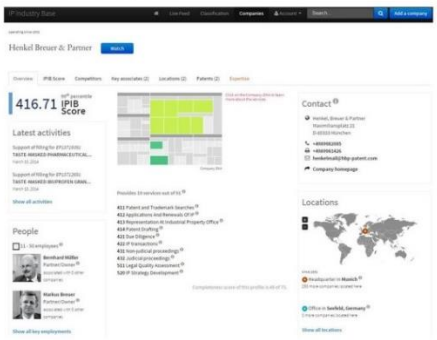

Figure 1. Example of IPIB data on one IP service provider.
http://ipib.ci.moez.fraunhofer.de/

Example 1: Bayh-Dole Act (1980)

The emergence of novel IP services (*Service 200: Matchmaking & Trading*) in the beginning of the 1980s is an interesting phenomenon related to changes in the U.S. patent law, the so-called "Bayh–Dole Act" or "Patent and Trademark Law Amendments Act". Suddenly, public research entities needed external knowledge and started outsourcing IP trading related services. The volume of the IP service industry has witnessed growth rates ever since, and new services, such as in *Service 600: Media & People*, have been valued additions to the market.

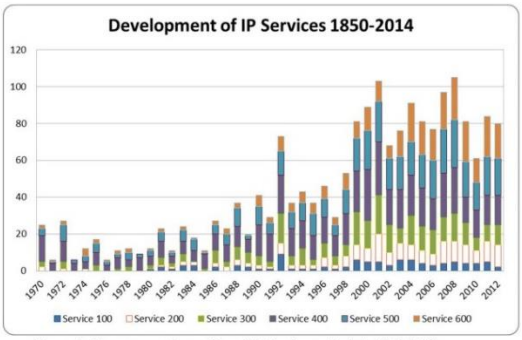

Figure 2. Emergence of new IP-centric Business Models 1970-2012

Table 1. IPIB service classifications

Service 100 *100*	*IP-related Finance Services Services*	*Service 400*	*Legal Services Services*
Service 200 *200*	*Matchmaking & Trading*	*Service 500*	*IP Consultancy Consultancy*
Service 300 *300*	*IP and Portfolio Processing Processing*	*Service 600*	*Media & People People*

Example 2: Collapse of the Soviet Union (1992)

The year 1992 has been outstanding on the political and economical level. The collapse of the Soviet Union led to the registration of a huge number of new IP business models in the newly reformed republics, which is reflected in the jump of registered IP services in 1992, an outlier year amongst the analyzed decades.

Example 3: Financial crises

Since the 1980s the IP service industry has shown almost steady growth, but in the year 1997 the overall number of globally registered IP service providers suddenly dropped due to the financial crisis in Asia. Dips in the number of new registered IP service businesses in the years 2009 and 2010 reflect the 2008 global financial crisis.

Concluding remarks

We have shown that the major market shocks of the past four decades are well recorded in our IP service industry data base. This makes it an excellent analytical tool for FTA approaches. IP service market data can provide powerful insights to market analyses. With the on-going automatic data collection methods by IPIB new possibilities for FTA practices are now accessible.

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www.jrc.ec.europa.eu

Joint Research Centre

Appendix 3

The very first prototype of IPSC sent out for information gathering purposes and first evaluation of the IPSC in 2012.

100 IP-related Finance Services

Resource allocation as well as resource management, acquisition and investment. In other words, finance deals with matters related to money and the markets.

110 Investment Products Based on IP

Services similar to traditional venture capital (VC) or private equity firms' services, but specializing in spinning out promising non-core IP which has become "stranded" within larger technology companies, or creating joint ventures between large technology companies to commercialize the technology and monetize the associated IP. IP private equity and venture capital firms raise funds from institutional investors such as companies, banks, governments or high net worth individuals, as well as private equity fund managers themselves.

111 Developing (issuing) IP-based Investment Products

Creating (and managing) several IP venture capital and/or private equity funds.

112 Being an IP-based Investment Product

Single IP Venture capital or private equity fund

120 Investment Products based on Royalty Liquidation/streams

Services related to the counsel, assistance and/or providing capital to patent owners performing IP securitization financing transactions (which resemble the more common mortgage-backed securities).

121 Developing Issuing IP-based Investment Products

Creating (and managing) investment trust that gets income from royalties.

122 Being a Royalty-stream Based Investment Product

An investment trust that gets income from royalties.

130 Financing IP and Innovation Processes

Providing capital for IP creation and aggregation.

131 Private Financing

Related to service of providing private financing for IP owners, either directly or as intermediaries, usually in the form of loans (debt financing), where the security for the loan is either wholly or partially IP assets (i.e., IP collateralization).

132 Public Funding

Similarly to private funding (see 131), government funding to develop further specific technology areas or promote certain technologies.

133 PPP Financing

Similarly to private funding (see 131), composition of public and private funding for IP creation.

140 IP Insurances

Intellectual Property Insurance service protects companies for copyright, trademark or patent infringement claims arising out of the company's operation. It pays the defense costs and any judgment up to the policy limits.

141 IP Litigation Insurances for Inventors

Insurances focused on inventors that cover legal fees for claiming and litigating own intellectual property rights. IP coverage helps pay the legal expenses of suing an individual or firm that has violated your intellectual property rights.

142 IP Litigation Insurances for Third-parties

Insurances that cover legal fees related to IP litigation. Third party coverage protects you if you are sued for infringing on another party's intellectual property rights and it funds your legal defense.

200 Matchmaking & Trading

Services related to arrangement of intellectual property rights related development needs of companies with available resources. Trading involving exchange of ownership.

210 Matchmaking

Service of linking IP (development) needs with available resources (including researchers).

211 Onsite Matchmaking Services

Desktop-based matchmaking, conferences or forums created for purpose of connecting IP (development) needs with available resources.

212 Online Matchmaking Platforms

Web-based platforms for services connecting IP (development) needs with available resources.

220 IP Brokerage

Services related to assisting patent owners in finding licensees, buyers for their IP. Service includes negotiating IP related contracts, IP purchases, - or sales in return for a fee or commission.

230 IP Scouting

Specific services that help you to find necessary IP. It is a team of IP and technology experts or an expert who observes and recommends new promising IP for acquiring.

240 IP Auctions

A public sale in which intellectual property or IP portfolios are sold to the highest bidder

241 Onsite IP Auctions

Live IP auctions

242 Online IP Auctions

Web-based IP auctions

250 IP Exchanges

Traded exchanges (whether physical or online locations) similar to the NYSE and NASDAQ where yet-to-be created IP-based financial instruments would be listed and traded much like stocks are today.

260 Free IP Sharing

Defensive publishing or platforms where inventions are made public for free usage of the IP.

300 IP Portfolio Processing

Various services related to the creation of IP portfolios and partial management processes of the portfolio related to creating revenues out of IP.

310 IP Portfolio Management

Updating the patents the portfolio consists of (renewal and application included) as well as collecting royalty rates and dealing with licensing.

320 IP Pooling/aggregation

The process of scouting and acquiring existing patents.

321 Offensive IP pooling

The purchasing of patents in order to assert them against companies that would use the inventions protected by such patents (operating companies) and to grant licenses to these operating companies in return for licensing fees or royalties.

322 Defensive IP pooling

The purchasing of patents or patent rights to keep such patents out of the hands of entities that would assert them against operating companies.

330 IP Augmentation

IP creation, either creating new technologies by cooperating with other institutions and as a results being the owner (or co-owner) of the patents created out of that process; or developing new technologies and getting patents on them in-house, using own R&D resources.

331 IP Augmentation Through In-house Labs

Developing patents within the institution in order to develop technologies or IP portfolios

332 IP Augmentation Through Outsourcing

Services related to IP creation for organizations by third parties

340 Purchase and Sale of IP

Services that provide assistance with actions that involve exchange of IP ownership.

350 Licensing IP

Services of licensing and advising for licensing, e.g. done by Licensing Agents. An authorization (by the licensor) to use the licensed material (by the licensee).

351 Carrot Licensing

Services executing carrot licensing involve bringing together licensing partners voluntarily. A carrot patent licensing approach is appropriate when the prospective licensee is not practicing the patented invention and is under no compulsion to take a license.

352 Stick Licensing

Services pursuing stick licensing involve to some degree infringement. A stick patent licensing approach is applied when the prospective licensee is already using your patent technology and, thereby, infringing your patent.

400 Legal Services

Services involving legal or law related matters like issue of patents, preparation of patent filing documents and litigation processes.

410 IP Protection

Process of assuring legal rights to the objects of IP (e.g. inventions, literacy and artistic works, images, designs).

411 Patent and Trademark Searches

Prior art search and investigation and comparison of existing intellectual property rights and applications regionally and worldwide.

412 Applications and Renewals of IP

Applications for IP protection and renewals of IP protection at industrial property offices (e.g. EPO, DPMA, USPTO, JPO).

413 Representation at Industrial Property Office

Official representation of the IP owners at industrial property offices (e.g. in patent grant and litigation proceedings).

420 IP Contracting

The branch of legal services dealing with assisting with formal IP related agreements between parties.

421 Due Diligence

IP related due diligence services prior to IP transactions (e.g. licensing, acquisition, sale).

422 IP transactions

Negotiations for and draft of IP transactions (e.g. licensing, acquisition, sale of IP rights), and development of legal strategies for IP protection and use.

430 IP Litigation

A legal proceeding in a court or a judicial contest to determine and enforce IP rights.

431 Non-judicial proceedings

Legal services lying outside the proceedings in court (e.g. determination of possible infringement cases, negotiations for extrajudicial settlements).

432 Judicial proceedings

Legal services associated with the protection of IP in court (e.g. representation in civil and criminal proceedings of IP owner or alleged infringer of IP rights).

433 Arbitration and Mediation

Legal services covering the arbitration and mediation proceedings (e.g. preparation of claims, and representation of IP owners or alleged infringer of IP rights).

440 IP-granting Authority

Industrial property offices that grant and renew legal rights to the objects of IP (EPO, DPMA, USPTO, JPO)

500 IP Consultancy

Advisory services related to various IP aspects providing professional or expert advice in a particular area such as market specifics for precise industry for patenting, technology and IP roadmaps, and various analyses.

510 IP Portfolio Analysis

Services for assessment of patents.

511 Legal Quality Assessment

Examining the legal strength of patent.

512 IP valuation

Determination or estimation the market value for patents or the underlying technology. Includes the valuation of patent portfolios and technology.

513 IP Portfolio Landscaping

Assessment services that comprise mapping technology fields and existing patents according to the given patent portfolio and thus estimating its market position.

520 IP Strategy Development

Consulting services for examining the best solutions of IP usage and further development. Includes strategic planning of technology trajectories/technology paths and IP portfolio development.

530 IP-driven M&A Advisory

Services similar to traditional investment banking services – advising technology companies in their merger and acquisition (M&A) activities and earning fees based on the value of the entire deal (or apportioned according to the value of the IP within the deal).

540 Commercialization Support

Services related to marketing patented technologies, assistance with creating prototypes, helping to bring the products to the market.

550 Competitive Intelligence

Collection and analysis of IP related data. It is the service of defining, gathering, analyzing, and distributing intelligence about IP, IP holders, IP portfolios and any aspect of the IP environment needed to support executives and managers in making strategic IP decisions for an organization.

551 Industry Analyses

Examining existing competitors and companies involved in IP market

552 Technology Analyses

Examining patented technologies, their technical details and – requirements for patenting purposes.

553 Patent Analyses

Services related to examining existing patents and drawing conclusions on patenting related information/activities.

560 Crowd-sourcing Platform for Prior Art Search

Service that allows an organization or an individual to collaborate with a community to find out if a specific technology exists/is patented.

570 Fighting Infringement, Counterfeiting & Piracy

Services specialized on detecting and interfering IP infringements.

571 Infringement Intelligence

Services for searching and demonstrating IP infringements

572 Technical Infringement Analysis (software / Circuits)

Services that comprise the technical detection of infringements (e.g. reverse engineering).

573 Crowd-sourcing Platform for Infringement Search

Service that allows an organization or an individual to collaborate with a community to find out if an organization or inventor has been involved in litigations or not.

574 Collaboration with Customs

Assistance in searching and actively blocking infringed products through cooperation with customs.

580 Internationalization Support

Services for supporting internationalization and trade of IP. Includes assistance in finding investors and business partners abroad and also offering any advice in legal, strategic or politic topics for certain countries (e.g. local patent laws, local technologies and clusters, societal and environmental issues).

600 Media & People

Publications, journals, blogs and educational materials on IP topic as well as unions and IP interest groups.

610 IP related Education and Publications

Services based on specialized education and coaching in IP related topics and non-academic publishers specialized on IP topics.

611 IP related Education

Services based on specialized education and coaching in IP related topics.

612 IP related Publications

(Online) Journals focusing on IPR related topics. Includes internet blogs. Excludes IP-related scientific publications from 680 IP-related scientific research.

620 IP Software

Various gadgets and instructions and data stored electronically and created for evaluating patents and IP related features.

621 IP Portfolio Management Software

Software for Managing IP Portfolio (e.g. Licensing and collecting of royalties, Application and Renewal support, IP decision management or IP portfolio related business intelligence solutions)

622 IP Portfolio Management Software for Attorneys

Specialized IP Portfolio Management software for patent attorneys.

623 IP Valuation Software

Software that valuates patents and/or portfolios.

624 IP Search Software

Software or web-based platforms for searching patent databases (EPO, DPMA, USPTO, JPO). Includes further examining and monitoring of patent databases and providing patent information.

630 Patent Databases

Service related to organized collection of IPR related data, today typically in digital form. The data are typically organized to model relevant aspects of patents,

intellectual property, and protected technology in a way that supports processes requiring patent related information.

631 Patent document data

Services related to collecting data on patents.

632 Patent-based Public Stock Indexes

Stock indexes that are based on aggregated patent and technology value.

640 IP-centric HR services

Headhunting and scouting services specialized in persons in the field intellectual property.

650 Interest Group

Organizations with IPR related political or legal strategies as the main topic. Excludes associations of IP professionals.

660 Conferences and Meetings Specialized in IP Topics

Gatherings or meetings for IP consultation, exchange of IP related information, or discussion, especially ones with a formal agenda on IP related topics.

670 Association of IP Professionals

Networks and associations of professionals with business or academic interest in IP. Includes academic research groups and bar associations.

680 IP Related Scientific Research

Scientific research and publications in the fields of intellectual property (mostly in an economic or legal perspective).

Appendix 4

Second prototype of the IPSC finished by the beginning of 2014 after the interviews.

The Intellectual Property Services Taxonomy (IPST) defines types of business activities that are executed by companies active in the IP market. Each main category is divided in several subcategories.

100 Legal Services

Services involving legal or law related matters like issue of patents, preparation of patent filing documents and litigation processes.

110 IP Protection

Process of assuring legal rights to the objects of IP (e.g. inventions, literacy and artistic works, images, designs).

111 Patent and Trademark Searches

Prior art search and investigation and comparison of existing intellectual property rights and applications regionally and worldwide.

112 Applications and Renewals of IP

Applications for IP protection and renewals of IP protection at industrial property offices (e.g. EPO, DPMA, USPTO, JPO).

113 Representation at Industrial Property Office

Official representation of the IP owners at industrial property offices (e.g. in patent grant and litigation proceedings).

120 IP Contracting

The branch of legal services dealing with assisting with formal IP related agreements between parties.

121 Due Diligence

IP related due diligence services prior to IP transactions (e.g. licensing, acquisition, sale).

122 IP transactions

Negotiations for and draft of IP transactions (e.g. licensing, acquisition, sale of IP rights), and development of legal strategies for IP protection and use.

130 IP Litigation

A legal proceeding in court or a judicial contest to determine and enforce IP rights.

131 Non-judicial proceedings

Legal services lying outside the proceedings in court (e.g. determination of possible infringement cases, negotiations for extrajudicial settlements).

132 Judicial proceedings

Legal services associated with the protection of IP in court (e.g. representation in civil and criminal proceedings of IP owner or alleged infringer of IP rights).

133 Arbitration and Mediation

Legal services covering the arbitration and mediation proceedings (e.g. preparation of claims, and representation of IP owners or alleged infringer of IP rights).

140 IP-granting Authority

Industrial property offices that grant and renew legal rights to the objects of IP (EPO, DPMA, USPTO, JPO)

200 IP Consultancy

Advisory services related to various IP aspects providing professional or expert advice in a particular area such as market specifics for precise industry for patenting, technology and IP roadmaps, and various analyses.

210 IP Portfolio Analysis

Services for assessment of patents families and patent.

211 Legal Quality Assessment

Examining the legal strength of the patent.

212 IP Valuation

Determination or estimation of the market value for patents or the underlying technology. Includes valuation of patent portfolios and technology.

213 IP Portfolio Landscaping

Assessment services that comprise mapping technology fields and existing patents according to the given patent portfolio and thus estimating its market position.

220 IP Strategy Development

Consulting services for examining the best solutions of IP usage and further development. Includes strategic planning of technology trajectories/technology paths and IP portfolio development.

230 IP-driven M&A Advisory

Services similar to traditional investment banking services – advising technology companies in their merger and acquisition (M&A) activities and earning fees based on the value of the entire deal (or apportioned according to the value of the IP within the deal).

240 Commercialization Support

Services related to marketing the patented technologies, assistance with creating prototypes, helping to bring the products to the market.

250 Competitive Intelligence

Collection and analysis of IP related data. It is the service of defining, gathering, analyzing, and distributing intelligence about IP, IP holders, IP portfolios and any aspect of the IP environment needed to support executives and managers in making strategic IP decisions for an organization.

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274 Collaboration with Customs

Assistance in searching and actively blocking infringed products through cooperation with customs.

280 Internationalization Support

Services for supporting internationalization and trade of IP. Includes assistance in finding investors and business partners abroad and also offering any advice in legal, strategic or politic topics for certain countries (e.g. local patent laws, local technologies and clusters, societal and environmental issues).

300 Matchmaking and Trading

Services related to arrangement of intellectual property rights related development needs of companies with available resources. Trading involving an exchange of the ownership.

310 Matchmaking

Service of linking IP (development) needs with available resources (including researchers).

311 Onsite Matchmaking Services

Desktop-based matchmaking, conferences or forums created for purpose of connecting IP (development) needs with available resources.

312 Online Matchmaking Platforms

Web-based platforms for services connecting IP (development) needs with available resources.

320 IP Brokerage

Services related to assisting patent owners in finding licensees, buyers for their IP. Service includes negotiating IP related contracts, IP purchases, - or sales in return for a fee or commission.

330 IP Scouting

Specific services that help you to find necessary IP. It is a team of IP and technology experts or an expert who observes and recommends new promising IP for acquiring.

340 IP Auctions

A public sale in which intellectual property or IP portfolios are sold to the highest bidder.

341 Onsite IP Auctions

Live IP auctions

342 Online IP Auctions

Web-based IP auctions

350 IP Exchanges

Traded exchanges (whether physical or online locations) similar to the NYSE and NASDAQ where yet-to-be created IP-based financial instruments would be listed and traded much like stocks are today.

360 Free IP Sharing

Defensive publishing or platforms where inventions are made public for free usage of the IP.

400 IP Portfolio Processing

Various services related to the creation of IP portfolios and partial management processes of the portfolio related to creating revenues out of IP.

410 IP Portfolio Management

Services related to assisting with the documentation of patent process / patenting itself

420 IP Pooling/aggregation

The process of scouting and acquiring existing patents.

421 Offensive IP pooling

The purchasing of patents in order to assert them against companies that would use the inventions protected by such patents (operating companies) and to grant licenses to these operating companies in return to licensing fees or royalties.

422 Defensive IP pooling

The purchasing of patents or patent rights to keep such patents out of the hands of entities that would assert them against operating companies.

430 IP Augmentation

IP creation, either creating new technologies by cooperating with other institutions and as results being the owner (or co-owner) of the patents created out of that process; or developing new technologies and getting patents on them in-house, using own R&D resources.

431 IP Augmentation Through In-house Labs

Developing patents within the institution in order to develop technologies or IP portfolios.

432 IP Augmentation Through Outsourcing

Services related to IP creation for organizations by third parties.

440 Purchase and Sale of IP

Services that provide assistance with actions that involve an exchange of IP ownership.

450 Licensing IP

Services of licensing and advising for licensing, e.g. done by Licensing Agents. An authorization (by the licensor) to use the licensed material (by the licensee).

451 Carrot Licensing

Services executing carrot licensing involve bringing together licensing partners voluntarily. A carrot patent licensing approach is appropriate when the prospective licensee is not practicing the patented invention and is under no compulsion to take a license.

452 Stick Licensing

Services pursuing stick licensing involve to some degree infringement. A stick patent licensing approach is applied when the prospective licensee is already using your patent technology and, thereby, infringing your patent.

500 IP-related Finance Service

Resource allocation as well as resource management, acquisition and investment. In other words, finance deals with matters related to money and markets.

510 Investment Products based on IPR

Services similar to traditional venture capital (VC) or private equity firms' services, but specializing in spinning out promising non-core IP which has become "stranded" within larger technology companies, or creating joint ventures between large technology companies to commercialize the technology and monetize the associated IP. IP private equity and venture capital firms raise funds from institutional investors such as companies, banks, governments or high net worth individuals, as well as private equity fund managers themselves.

520 Investment Products based on Royalty Liquidation/streams

Services related to the counsel, assistance and/or providing capital to patent owners performing IP securitization financing transactions (which resemble the more common mortgage-backed securities).

530 Financing IP and Innovation Processes

Providing capital for IP creation and aggregation.

531 Private funding

Providing private financing for IP owners, either directly or as intermediaries, usually in the form of loans (debt financing), where the security for the loan is either wholly or partially IP assets (i.e., IP collateralization).

532 Public Funding

Similarly to private funding, government funding to develop further specific technology areas or promote certain technologies.

533 PPP Financing

Similarly to private funding, composition of public and private funding for IP creation.

540 IP Litigation Funding

Litigation funders are interested in providing financial means for IP litigation and particularly patent litigation cases for a fixed fee or % on the amount gained from an infringing party.

550 IP Insurances

Intellectual Property Insurance service protects companies for copyright, trademark or patent infringement claims arising out of the company's operation. It pays the defense costs and any judgment up to the policy limits.

551 IP Litigation Insurances for Inventors

Insurances focused on inventors that cover legal fees for claiming and litigating own intellectual property rights. IP coverage helps pay the legal expenses of suing an individual or firm that has violated your intellectual property rights.

552 IP Litigation Insurances for third-parties

Insurances that cover legal fees related to IP litigation. Third party coverage protects you if you are sued for infringing on another party's intellectual property rights and it funds your legal defense.

600 Media and People

Publications, journals, blogs and educational materials on IP topic as well as unions and IP interest groups.

610 IP related Education and Publications

Services based on specialized education and coaching in IP related topics and non-academic publishers specialized on IP topics.

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631 Patent document data

Services related to collecting data on patents.

632 Patent-based Public Stock Indexes

Stock indexes that are based on aggregated patent and technology value.

640 IP-centric HR services

Headhunting and scouting services specialized in persons in the field of intellectual property. It includes services that help to recognize outstanding inventors among other IP community members, HR recruitment platforms and conferences on IP related topics for HR people for networking purposes.

650 Interest Group

Organizations with IPR related political or legal strategies as main topic. Excludes associations of IP professionals.

660 Conferences and Meetings Specialized On IP Topics

Gatherings or meetings for IP consultation, exchange of IP related information, or discussion, especially ones with a formal agenda on IP related topics.

670 Association of IP Professionals

Networks and associations of professionals with business or academic interest in IP. Includes academic research groups and bar associations.

680 IP Related Scientific Research

Scientific research and publications in the fields of intellectual property (mostly in an economic or legal perspective).

Appendix 5

List of companies interviewed:

1. Breathing Buildings Ltd

Contact person - Shaun Fitzgerald (CEO)

Location: Cambridge, UK

Employees: 30

Founded: 2006

Provides low energy ventilation systems, using the principles of natural mixing ventilation in winter and natural upward displacement ventilation in summer. Systems are controlled by a logic controller responding to variations in temperature and CO2 levels. Operates in 50+ schools in the UK.

2. SmartMotor

Contact person - Alexey Matveev (Research manager)

Location: Norway

Employees: 34

Founded: 1996

SmartMotor manufactures Energy Efficient Motors (EEM) based on magnetic technologies that allows superior efficiency, more torque, and less noise production. The firm produces monitoring and control software as well as electronics components. SmartMotor's solutions are suitable for high effectiveness terrestrial and submerged applications in a range of markets including Renewable Energy power generation, Marine and Subsea engineering.

3. Micro-Vett

Contact person - Michele Pennese (R&D director)

Location: Italy

Employees: 55

Founded: 1986

Designs and manufactures a complete range of electric vehicles Working closely with large-scale vehicle manufacturers (FIAT, Piaggio and Iveco) and research institutes. Offers concrete solutions to mobility and environmental problems in urban areas.

4. Electro Power Systems

Contact person - Ilaria Rosso (R&D director)

Location: Italy

Employees: 35

Founded: 2005

Electro Power Systems develops, produces and markets fuel cell systems for power backup. The company's offering, Electro7, is the first multi-output fuel cell system for business continuity applications and provides 100% clean power with virtually unlimited autonomy. Electro7 provides up to 7 kW of continuous, on-demand power and is currently considered a class 1 UPS. The product is currently used by the telecommunications industry as a substitute to traditional energy stations. Additionally, Electro7 holds a competitive advantage as the lightest and most efficient hydrogen stationary system on the market. The company's product is targeted towards use by telecom operators, power utilities, IT infrastructures, and broadcasting infrastructures. The company's customers include Telecom Italia, SMAT Torino, AEG Ivrea, and Total Deutschland.

5. Intelligent Energy

Contact person – Daniel Ninan

Location: UK

Employees: 101

Founded: 2001

Intelligent Energy develops clean power systems based on proprietary fuel cell and hydrogen generation technology platforms to create bespoke power systems for

OEMs and their global mass markets. The company covers four key markets: aerospace and defense, distributed generation and portable power, oil and gas and motive power. Intelligent Energy's product range includes fuel cells, which use proton exchange membrane technology, and distributed hydrogen generation from a wide range of sources. Furthermore, the company works closely with business partners to design and integrate their proprietary systems into the products.

6. Solarlite

Contact person - Moritz von Plate (CFO)

Location: Germany

Employees: 180

Founded: 2005

Develops and builds decentralized solar thermal parabolic trough plants (CSP concentrated solar power) for combined heat and power generation. Power plants have an electrical output from 500kWe to up to more than 30MWe. Applications include electricity production and consumption of industrial facilities.

7. Eco Plastics

Contact person – Jonathan Short (CEO)

Location: UK

Employees: 50

Founded: 2000

Reprocesses post-consumer waste plastics, accepting mixed plastic bottles sorting them by color and polymer. Operates Europe's largest and most technically advanced facility sorting 140,000t of plastics each year.

8. Green Gas International

Contact person – Marco van der Hijden (Marketing manager) & Marieke Andringa (Legal Counsel)

Location: Netherlands

Employees: 499

Founded: 2005

Green Gas International converts methane emissions from coal mines and landfills into clean energy and carbon credits. The company partners with coal mine and landfill owners to offer a commercially viable solution for gas management by providing gas collection, gas drainage, project management, operations and maintenance, carbon credit application assistance and financing options. Green Gas seeks to curb climate change at the industrial level by bringing their solution to businesses where methane conversion is outside the main focus of their operations. The company's solutions are based on the Kyoto Protocol's Clean Development Mechanism and Joint Implementation.

9. Nualight

Contact person – Dr. Vincent Guenebaut (Head of product development)

Location: Ireland

Employees: 80

Founded: 2004

LED lighting company specialized exclusively in lighting for food retail displays

Customer base includes Tesco, Carrefour, Migros, Sainsburys etc. Recently acquired Lumoluce, a Dutch LED accent lighting company with power management expertise.

10. Solarcentury

Contact person: Alan South ()

Location: UK

Employees: 200

Founded: 1998

Solarcentury operates as a solar energy company which designs and supplies solar energy solutions. Solarcentury offers support and guidance throughout the entire micro renewable planning and development process, from land appraisal through to design, installation and marketing. Solarcentry offers Residential Solar, where they design and supply building integrated solar photovoltaic and thermal systems for home owners and house builders; Commercial Solar, where they design solar energy systems and provide complete turnkey solar installations for feed-in tariff projects, offices and commercial and agricultural buildings and Architectural Solar, where they design and supply architectural solar solutions which integrate solar energy systems with standardized building components, making solar part of the fabric of buildings.

11. Ashwood Automotives

Contact person: Jeremy Ellison (CFO)

Location: UK

Employees: 15

Founded: 2003

Ashwoods Automotive is a provider of hybrid-electric vans and hybrid drive systems. The company's hybrid vans are proven to reduce emissions and fuel cost by over 15% compared with the equivalent diesel variant. Additionally, Ashwoods offers a hybrid drive retrofitting kit for panel vans. The company's proprietary system delivers a reduction in fuel consumption by 15-25%, by recovering the kinetic energy usually wasted through braking or deceleration. The recovered energy is stored in a lithium-ion battery delivered to the wheels via a high efficiency electric motor.

12. ZiPee Bikes

Contact person: Naomi Aptowitzer (CEO)

Location: UK

Employees: 4

Founded: 2006

ZiPee Bikes offers electric bikes targeting short trips of under 20 miles. The company also provides training and education to young people in the environment. The company's goal is to reduce CO2 emissions by decreasing the amount of cars and fossil fuel-based trips whilst at the same time raising the awareness of alternative transport and renewable energy via the use of electric mopeds and bicycles.

The idea comes from the fact that the majority of trips made in the car are under 12 miles and car pollution starts almost immediately from turning on the engine. Catalytic converters only start reducing emissions once the engine reaches hot temperatures, usually after five miles. A ZiPee bike is road tax free and does not require a license. It can be driven by anyone over the age of 14. The founder, Naomi Aptowitzer, collected the prestigious Green Apple Award 2008 for Training & Education Environmental projects at the House of Commons.

13. ChromoGenics

Contact person: Thomas Almesjö (CEO)

Location: Sweden

Founded: 2003

Employees: 20

ChromoGenics has an internationally leading position for electrochromic materials, and many years of research at the Ångström Laboratory has led to a unique technology and patent portfolio. By using a multilayer-structure comprising several different materials between two plastic films, one creates a flexible and light-weight electrochromic foil capable of changing its degree of darkness when electric voltage of a few volts is applied.

14. PowerWind

Contact person: Philipp Degenhardt (Research & Development Engineer)

Location: Germany

Founded: 2007

Employees: 140

OEM of onshore wind turbines (500 kW, 850kW, 900 kW and 2500 kW) and service provider. Focuses on community-scale wind projects (1-30MW and mostly locally owned). 5,000 m² manufacturing facility with two production lines

15. Enertime

Contact person: Fabien Michel (Deputy General Manager)

Location: France

Founded: 2008

Employees: 11

Offers turn-key solutions for the industrial scale distributed renewable electricity and heat production with biomass, waste heat, and thermodynamic solar and geothermal sources.

Uses a proprietary technology (ORC) working with non-flammable non-toxic fluid.

16. Climatewell

Contact person: Per Olofsson (CEO)

Location: Sweden

Founded: 2001

Employees: 63

ClimateWell develops, produces, and markets indoor climate solutions for the use in residential, commercial, and industrial structures.

The company's proprietary heating and cooling technology is able to store energy and enables hot water to cool or heat any structure on-demand and without the use of electricity. This renders oil, electricity, and gas unnecessary for indoor climate control.

ClimateWell's solution addresses both the rising cost of energy and the need to reduce global CO2 emissions. According to the company press, the average family can reduce their CO2 emissions by up to 15 tons per year by switching to a ClimateWell system, whereas changing from a conventional car to a hybrid will save approximately 1 ton of CO2 emissions per year.

ClimateWell is based in Sweden with manufacturing operations in Spain and research in Finland.

17. Sensima Technology SA

Contact person: Jens Muttersbach (CEO)

Location: Switzerland

Founded: 2008

Employees: 10

Sensima Technology SA is a semiconductor company specialized in the design and distribution of fully integrated CMOS magnetic sensors. Based on its proprietary Hall cell design, Sensima is currently developing and marketing a range of sensors for angular positioning and magnetic field measurement applications. Sensima is committed to bringing high-end magnetic sensing products to the market by leveraging the full potential of standard fabrication technologies, thus offering high reliability and repeatability at a reasonable prize. Thanks to its highly competent team of scientists and engineers, Sensima Technology offers you best-in-class Hall sensors for angular position sensing and magnetic field measurement.

18. Highview Power Storage

Contact person: Emma Gibson (Operations Manager)

Location: UK

Founded: 2005

Employees: 40

Highview Power Storage is a developer of utility-scale energy storage and power systems to optimize energy resources and help decarbonize the grid. Its proprietary process uses cryogenic (liquefied) air or its principal component, liquid nitrogen, as the working fluid and the media for storing and/or transporting energy.

19. SCFI Group

Contact person: John O'Regan (Operations Manager)

Location: Ireland

Founded: 2007

Employees: 60

SCFI has developed technology called AquaCritox® which can completely destroy organic waste and generate renewable energy. AquaCritox® process uses the properties of supercritical water to provide an economical and sustainable solution to the management of liquid organic wastes. The technology provides a rapid, clean and sustainable method of dealing with liquid organic waste streams such as high strength industrial wastewater, sewage sludge and bio solids and enables precious metals recovery from catalysts.

20. Xeros

Contact person: Steve Jenkins (IP Manager)

Location: UK

Founded: 2001

Employees: 26

Xeros Ltd. is a new company focused on the development of "virtually waterless" laundry cleaning. Harnessing over 30 years of research by Professor Stephen Burkinshaw and the University of Leeds, Xeros is the brand name for a patented polymer based cleaning that creates a step change advantage in the cost and environmental impact of aqueous wash cleaning.

21. Goliath Wind

Contact person: Lars Mach (CEO)

Location: Estonia

Founded: 2008

Employees: 40

GOLIATH Wind introduces a generation of wind turbines that takes gearless drive train to a new level. GOLIATH Wind has built several ring generators of up to 4.4 meters in diameter. GOLIATH uses its own innovative ring generator technology with permanent magnets from special composites in order to reach the maximum corrosion protection.

22. PSE

Contact Person: Andreas Härberle (CEO)

Location: Germany

Founded: 1999

Employees: 84

PSE specializes in technology and consulting in the field of solar energy. Its subsidiary, Mirroxx, launched in 2008, engages in the worldwide marketing of linear concentrating Fresnel solar collectors for the production of solar process heat and solar cooling.

PSE builds and installs high quality test stands for the testing of thermal solar collectors. Customers include testing laboratories, research institutes and collector manufacturers all over the world. In addition, the company offers consulting, strategic development and monitoring of rural electrification projects in countries such as Bangladesh, South Africa and Pakistan. PSE also offers expertise in R&D event and project management, as well as studies in the field of solar energy.

The company was founded in 1999 as a spin-off of the Fraunhofer Institute, the largest solar energy research institute in Europe, from whom it still receives IT support and supply of temporary workers. Dr. Andreas Häberle is the company's CEO.

23. greenTEG

Contact Person: Thomas Helbling (head of R&D)

Location: Switzerland

Founded: 2009

Employees: 15

greenTEG GmbH develops the new generation of thermoelectric generators. greenTEG's technology enables efficiency in future energy conversion processes. Based on a novel manufacturing process developed at the ETH Zurich, greenTEG manufactures thermoelectric generators (TEGs), cooling elements (TECs) and heat flux sensors in a totally new manner, resulting in flexible and low cost devices.

24. Kebony

Contact Person: Per Brynildsen (CTO)

Location: Norway

Founded: 1997

Employees: 53

Kebony is a wood processing company. Its unique process method is based on a practice where sustainable wood is made more durable, harder and more stable using liquids from bio waste material. Kebony is a sustainable alternative to hardwoods from tropical regions. The products resemble teak and other tropical varieties of wood. It is dark, and acquires a silver grey patina over time if left untreated. One of the notable benefits of Kebonization is the resistance to weather and wear. Other notable benefits are exceptionally good decay resistance and long life span. This durability is achieved without the drawbacks associated with traditional impregnation methods.

25. GreenPeak

Contact person: Wilco van Hoogstraeten (CTO)

Location: Netherlands

Founded: 2007

Employees: 40

GreenPeak Technologies offers innovative ultra-low power wireless RF communication controller chips for the Smart Home.

GreenPeak is a leader in highly integrated silicon solutions for residential applications. The set-top box becomes a Home Control Box and monitors applications in and around the house, such as remote controls, security, energy efficiency, consumer electronics and appliances, home health care, HVAC and lighting.

GreenPeak brings wireless and green solutions for residential control networks with unique features that provide better range, make it robust to Wi-Fi interference in combination with high reliability and standard compliance.

26. CPM Compact Power Motors GmbH

Contact person: Thomas Leiber (Founder)

Location: Germany

Founded: 2008

Employees: 15

CPM develops and manufactures the world's most efficient and compact drive solutions, all made in Germany. CPMs compact, high-performance drive units couple a brushless synchronous motor with a fully integrated control unit, provide powers ranging from 500 W to 100 kW and are particularly well suited for all types of vehicle and battery-driven applications as well as for all energy recovery tasks.

Appendix 6

Questionnaire for the first set of interviews for evaluation after conceptualization phase.

The questions discussed with clean technology companies during semi-structured telephone interviews:

1. On scale from 1 to 10 how important are intellectual property rights for their organization/specific department?
2. Which intellectual property related services are they currently using the most?
3. Which intellectual property related services are they currently missing (if any)?
4. Why are they missing some intellectual property related services, are there any barriers to use any?
5. (After showing them the categorization of all intellectual property related services in Europe) Which of the services named in intellectual property services cataloguing they use? Do they feel that some functions are missing from there?
6. What do they consider in intellectual property services perspective to be clean technology industry specifics? How do they differ from other industries (in case they do differ)?

Synopsis

1. On scale from 1 to 10 how important are intellectual property rights for their organization/specific department?

First of all, patents are considered very important for the clean technology industry. The average score from 1 (lowest) to 10 (highest) for our sample was 7,56. That indicates that under the current law scheme, IPR plays an important role and cannot be overlooked. The value of patents was well recognized by most of the interview partners. Patenting was seen as a process that might harm companies' activities due to disclosing valuable information that can be discovered by competitors. Small versus big technology companies' pitfall in court systems was brought up in several cases. The challenge comes in after filing if a large or several large companies are

potentially infringing your IP and have significant resources to extensively fight in various court systems with the smaller firm until the smaller clean technology firm has lost all its resources and might be facing bankruptcy - even if the larger firm is in the wrong.

2. Which intellectual property related services are they currently using the most?

One of the key findings from the conducted interviews was that almost all clean technology companies need assistance with legal steps of patent proceeding and processes. Even when having an in-house lawyer, is it still necessary in most cases to consult a patent attorney on legal aspects. All of the companies interviewed outsource legal services at least to some extent.

Managing the IP portfolio is usually done in the house according to our interview partners, and that was suggested by literature as well (Tietze, et. al 2010; 2007). The final decisions on what to patent and if to patent is up to the companies who own corresponding technological innovations. Different stages for coming up with these kind of decisions might be outsourced. Many of the interview partners have used various consulting services, and some have been disappointed in the results due to the lack of technology-specific knowledge, whereas others have received valuable help for making strategic decisions related to IPR.

3. Which intellectual property related services are they currently missing (if any)?

Interestingly, clean technology companies who produce their own technologies might have unused IPR that they would be willing to license out. Licensing out unused IPR would earn extra revenues for clean technology companies for advancing their businesses. The IPR licensing service was missed by three interview partner, furthermore that service was falsely assumed to be missing from current IPR market from one of the interview partners. It proves that clean technology companies are not aware of their current possibilities and they do not have good access to information regarding IPR services and service providers. Going further to licensing services – a wind turbine producer, for example, mentioned that their turbine

technology IP could be easily used in submarine industry, which is not their competitor. Therefore, licensing out to a different industry would create relatively risk free (it would be bad business strategy to license to competitors, but not to other industries) extra income (licensing revenues). Consequently, for clean technology sectors, service providers related to licensing activities might see an increase in demand for their services. On the other hand, few of the interview partners stated that they do not see licensing out as an extra source of revenue; IPR exchange and licensing were in some ways perceived as "a dirty game" (e.g. ChromoGenics, Nualight). Therefore, the mind-sets for some of the clean technology companies might have to be changed first.

4. Why are they missing some intellectual property related services, are there any barriers to use any?

For start-ups, patenting is seen as costly and going to court is very resource demanding. Several clean technology companies mentioned that they are currently missing some IPR-related services, and the most common barrier to using some of the services they would like to outsource was the information barrier. Clean technology companies simply were not aware of their opportunities, and once the service they felt they are missing was named, it was rather easy to find that kind of service or services from the taxonomy. It means these services do exist, and technology companies in Europe are just not aware of their IPR service outsourcing opportunities.

5. After showing them the categorization of all intellectual property related services in Europe - which of the services named in intellectual property services cataloguing they use? Do they feel that some functions are missing from there?

Clean technology companies are not aware of the extent of IPR-related services that are currently offered on the IPR market. That can be concluded from their replies when answering which IPR services they are aware of. All twenty-six interview partners found that the IPR services classification used as basis for the interviews was comprehensive and covered all known or even yet unknown, currently available IPR-related services. Additionally, the document sent to them before the interview made

them aware of many IPR services that they did not know about so far. Many of interview partners did agree that the European IPR services market is comparable to a "black-box". Most services get acquired to personal networks and connections. In the sample, there was one highly qualified IPR expert with more than 25 years of experience in the IPR field, and during our interview, it became obvious that having such a person in-house makes outsourcing some IPR tasks to IPR service providers unnecessary. Nevertheless, many clean technology companies have emerged IP management tasks with other responsibilities and thus it can be the CEO, R&D manager or even sales person who is made responsible for IPR. That is mainly due to the lack of resources and therefore IPR can be left with-out proper attention. Therefore, outsourcing patent related services to reliable service providers can be seen as a great plus.

6. What do they consider in intellectual property services perspective to be clean technology industry specifics? How do they differ from other industries (in case they do differ)?

An important observation on clean technology specifics related to IPR highlighted that indeed some very broad patents exist and the number of infringement is assumed to increase in the future. Most of the interview partners believe that the number of infringements will increase in the future, but if this is purely clean technologies specific, the number cannot be predicted. Few of the interviewed felt strongly that it is not just clean technologies-specific phenomenon. Nevertheless, service providers that help clean technology companies with court proceedings and detecting cases on infringements might become more popular. This occurrence might take place due to several reasons, mainly due to very broad patents already granted in the past and clean technology companies having to patent narrower and narrower nowadays. Narrow patenting is also taking place because of strategic or safety reasons to keep some of the technical details and knowhow a secret, because patent filing process makes your technology easily discoverable for competitors (Bar-Gill and Parchomovsky, 2003). This patenting behavior among companies could possibly increase infringement possibilities and cases in near future (some interview partners gave and approximate five years' timeline). About a third of the interview

partners did not see any difference between clean technology and other industries when it comes to IPR-related services. Due to very wide sample selection of clean technology companies, industry specifics were not evident. Companies inter-viewed were active in various fields, and therefore had each different insight. Additional aid from governments was expected in various cases as clean technology was considered to have great social benefits, and therefore it was assumed to be in the interest of governments to promote and support the industry. According to the expertise of experienced IPR managers interviewed, clean technology does not stand out in great extents when it comes to IPR-related services. The IPR-related service market in general is complex to grasp. Companies, not being aware of the full extent of the IPR-service market, are consequently not well aware of the market specifics for their industry. Interview partners seemed open minded and willing to use reasonably useful IPR services. Therefore in the future the percentage of outsourced IPR-related tasks is predicted to increase for clean technology sector.

Appendix 7

Questionnaire for the second set of interviews for evaluation before the formalization phase. Below the questions and synopsis of the replies can be found.

1. What are the biggest problems on IP markets at the moment?
2. Do you think creating a comprehensive intellectual property services taxonomy defining all the business models of IP practitioners on current IP markets would solve any of these problems?
3. How do you feel that intellectual property services taxonomy will help various stakeholders on IP markets (technology companies, IP practitioners, government etc.)?
4. In your opinion, where could the intellectual property services taxonomy (IPST) become most useful to solve the IP market biggest problems?
5. Do you feel like the list of various IPR services has covered everything?

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

6. Are there any IP services that you are aware of that is missing from the list (please see http://ipib.ci.moez.fraunhofer.de/ipst ?)
7. Would you agree with dividing the list of IP services into 6 main categories?

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

8. Do you have further suggestions regarding improving the IPST? Loose end question: Would you change anything about the questionnaire? Synopsis

1. What are the biggest problems on IPR markets at the moment?

For entrepreneurs with science degree IPR markets are not a well understood term even. IPR related processes are seen as time consuming and complicated "As someone who wants to venture into innovation through product design, I find the long time scale to securing a patent on any invention a barrier. If the time to secure IP is reduced and the process simplified, I feel it encourages and promotes innovation and entrepreneurial activities." Internalization seems to be the main concern still and of course the general awareness of the IP issues in emerging markets. The transfer of unique ownership advantages between countries through markets are problematic. Maintaining IP value or properties associated with the IP across different countries could be improved.

For IPR service providers the main issues are patent Thickets (e.g. Smartphone industry and Mobile Operating Systems), access to Standard-essential Patents, problems related to Refusal to License, ill-defined IPR. The markets were seen as quite illiquid and IP assets very difficult to value.

A IP law specialist stated that there are a lot of practitioners in the IP field who are not very well qualified. Examples of Indian IP service providers were given. The professions and qualifications in the IP field have been quite unregulated and there are no international standards (with some exceptions) how to evaluate who is a professional and who is not. For example, in the patent searching field, it's a big problem. Fortunately, some organizations are planning to create an internationally standardized qualification examination system. Another example is European Patent Attorney qualification where there are very strict and strong requirements to qualify. Thus there are very big differences between different IP professions regarding the qualifications.

One problem on IP markets for innovation policy expert was stated to be is the lack of institutional harmonization on a global level (or, at least including the main markets), a problem that leads to conflicts and imperfections, especially regarding appropriate conditions but also knowledge and technology transfer and access to emerging markets when IP rights are not secured. Other problem concerns the lack of proper business models that could capture the right value from the IP. This is not,

however, a structural problem, but an inherent feature of the IP market that could be somehow "softened".

In general it was discussed that the world has changed (economically, technologically, sociologically) - today technologies and business models that did not exist 5 years ago are in use (social networking; crowdsourcing, crowd- & micro funding, micropayments; 3D scanning, printing & drawing; Big, Open & Linked data; Wearable technologies & sensors; virtual & digital currency; smartphones; augmented reality; electronic paper, DNA as an information storage medium; etc.), but the principles of IP protection and the IP protection system is quite the same as it was a couple of hundred years ago. It is very interesting what will happen in the IP protection field in the next 5-10 years. But this has caused the raise of new business models also in the IP field.

2. Do you think creating comprehensive intellectual property services taxonomy (IPST) defining all the business models of IP practitioners on current IP markets would solve any IP market problems?

It was believed by innovation policy and technical experts to greatly help new businesses as a reference where to turn for help on different specific services.

It was clear from the replies that IPST would not solve all the problems, but surely builds a path towards the solutions. With clarity on the business models and different actors involved, it makes it easier to improve the efficiencies of the market as mapping of IP business models could improve IP transparency hence improve conditions on IP markets. This could e.g. specifically help firms to access and/or compete in IP-intensive industries by giving them information on IP ownership and related business models and enable them to make better decisions. It helps to define who is who in the IP field and compare different service providers in the same category. However, the results of increased transparency were believed to be limited by IP service providers themselves since it would not necessarily solve problems related to the possibility to actually gain IP access on fair (non-discriminatory) terms.

3. How do you feel that intellectual property services taxonomy will help various stakeholders on IP markets (technology companies, IP practitioners, governments etc.)?

It was believed to help technology companies the most. It may also help to clarify and reduce the time taken to secure IP for innovative products according to the entrepreneur interviewed. "If I need professional help in specific field (for example trademark valuation, copyrights litigation) in some specific country (Ukraine or Uganda) and the company has defined its practicing areas in a tool like the IPIB, it might reduce time connected to sourcing for IP services. Of course there are many other directories of IP service providers, but as far as I know they don't have such taxonomy/ categorization."

It improves the matching of demand and supply. IP practitioners could experience more inquiries directly related to their core competences. Actors can better define their services/products and the demand side can more easily go to the most relevant supplier. In theory it should also bring down costs as it decreases the need for a middleman. As for example it would be enabling potential IP licensors to make better decisions by increasing transparency on IP markets. It will give a clearer idea of the services tech firms can have access to when dealing with IP. On the other hand, IP firms can position themselves within some categories and know more about their direct competitors and potential partners. To sum up, for the firms engaged it will help to create a clearer picture of all IP services out there.

It was considered not to have much effect on government institutions.

4. In your opinion where the intellectual property services taxonomy (IPST) could become most useful to solve the IP market biggest problems?

Huge benefit to start with would be raising awareness on complexity and multi-step process of the IP markets. Reducing uncertainty on the market level from: categorizing the services and positioning competitors; fostering partnerships; facilitating the access to data from IP firms and governments; encouraging academic analyses and construction of databases dealing specifically with the IP market.

By creating international qualification standards based on IPST, the IP market could become fairer. IPST could serve as a means to create publicly available knowledge and thereby being a market coordination device. If this would be generally accepted, overall competition on IP markets could be fostered. Especially by giving SMEs (perhaps not having sufficient resources or being able to screen the IP business models on their own) the ability to better gain information which is important for decisions for competing or accessing IP markets.

It was indicated to accelerate IP trading because as it usually involves the need for a range of services from valuation, legal support, brokerage etc.

5. Do you feel like the list of various IP services (http://ipib.ci.moez.fraunhofer.de/ipst) has covered everything?

Average score 5 (scale 1 to 7).

It was suggested to bring in copyright, trademark and other types of IP services.

6. Are there any IP services that you are aware of that is missing from the list (please see the IP services categorization)?

Most found the IPST comprehensive. Nevertheless, copyrights and trademarks related services were found to be missing by an IP law specialist with the following justification: "Patent searches are divided into at least ten or more different types of searches and analysis, same with trademarks; IP Valuation is much more than just patent valuation (how about trademarks, copyrights valuation?); etc. A lot of services are missing. At the moment it is very patent centric, but IP is much more than just patents."

It was suggested to combine IP Protection and Fighting Infringement, Counterfeiting & Piracy in one single and more elaborate category.

7. Would you agree with dividing the list of IP services into 6 main categories?

Average score 4.2 (scale 1 to 7).

It was suggested to add some more main categories, for example Search & Analysis; International Organizations. Most troublesome was the category 600. According to the interviews it should be divided into at least two or three categories - for example software development and education/HR are quite different. The coverage of group 600 seemed too broad with some subsections having little similarities.

8. Do you have further suggestions regarding improving the IPST?

"Please add opportunity to suggest new categories, something similar like your "Contribution" button. Use more crowdsourcing!"

"I suggest that the categories 630 (Patent Databases) should be placed in separate category. I don't consider IP software (620) as media, but as a tool usually developed from IP Consultancy firms (500)."

"What is very important in IP businesses is trust. The clients find service providers mostly based on personal recommendations. IPST should be commonly accepted and trusted to make a change."

Appendix 8

Tove Graulund

She is the Principal of Graulund Consulting, and in her present role she primarily acts as a business development consultant to IP law firms. She offers consulting services in the areas of IP management and IP strategy to businesses as well as strategic and business development services to consultancies, firms and service providers in IP.

She is a European Trademark and Design Attorney. During her professional career she worked with different aspects of IP, both as a hands-on expert, a manager and a representative of an interest group. She has extensive experience in dealing with IP as an in-house expert and developed several tools to create increased awareness and understanding of IP in a business with significant international activity.

As Chairman of MARQUES she worked with a team of individuals from different cultures to develop the vision and initiated the growth of the organization. She has been active for many years in lobbying activities and have in-depth knowledge of the future development of the IP market. She represented MARQUES at the OHIM Administrative Board and Budget Committee 2009-2013. She is the chair of MARQUES Task Force on the reform of the European trademark systems.

As the director of an IP firm she worked with clients in several large and smaller companies while being responsible for cross-country development.

Specialties: Unique combination of IP expertise, management experience, in-depth understanding of the industry and years of business experience. Trademark, design, domain name management, brands and IP, IP in a fast moving consumer goods company and the role of intellectual property, management and leadership, understanding the IP market, IP associations. Business development of IP firms, marketing and promotion in the IP community. IP policy.

Tom Hoehn

He is a visiting professor at Imperial College Business School London where he teaches MBA courses on Merger Control and the Valuation and Pricing of Intellectual Property. Until November 2009 Tom Hoehn was a Partner at Pricewaterhouse

Coopers and responsible for its global Economics practice. On 1 September 2009 he was appointed as Panel Member of the UK Competition Commission. Tom Hoehn has held teaching and research positions at the University of Zurich and the LSE, has a MSc in Economics from the London School of Economics and Lic.oec, HSG, from the St. Gallen Graduate School of Public and Business Administration of Economics.

Tom Hoehn specializes in and publishes on the economic aspects of intellectual property, competition policy, the economics of sport and media. His paper with Stefan Szymanski on 'The Americanisation of European football', published in Economic Policy (1999) is frequently cited and continues to be topical. Tom Hoehn sat on the expert group preparing the UK Enterprise Act (2002), and recently led a major international research programme on the design and implementation of merger remedies

In the course of his consulting career since 1984, Tom Hoehn has advised clients on over 100 assignments and presented expert evidence in antitrust proceedings across Europe. Tom Hoehn has acted as Monitoring Trustee in over a dozen Merger remedy cases for GE, Pernod Ricard, P&G Air Liquide etc. His recent consulting experience includes assisting Microsoft in the implementation of the 2004 Commission decision regarding the provision of interoperability information on the Windows Server Operating System and from 2001-06 advised the BBC Governors on fair trading and competition law compliance.

John Pryor

He is a director at Ernst and Young where he specializes in IP Strategy Consulting across a broad range of clients and sectors. In parallel he is the director of Exalt IP.

He is an international entrepreneurial executive with a portfolio of skills including strategy, deal making, business development, marketing, people leadership and technology management.

He also has extensive knowledge of intellectual property (IP) strategy and a thorough understanding of how businesses can best manage their IP for optimum value. Since 2009 Intellectual Asset Magazine has named John Pryor one of the 300 Leading IP Strategists from around the world.

John Pryor served as Senior Vice President at ICAP Patent Brokerage, LLC. Mr. Pryor was Vice President at CPA Global. He also served as a Strategy Consultant at Accenture and Sales and Marketing Manager at Procter & Gamble. He has an MBA from Warwick Business School and a BSc (Hons) from Kings College, University of London.

Donal O'Connell

He is a consultant at Avancept, LLC, and formerly a vice president of R&D and a director of IP at Nokia. He had a long career at Nokia for 21 years and has wide and varied experience in the wireless telecoms industry, having worked for periods in the Netherlands, the UK, USA, Finland, and HK.

Donal O'Connell is an Adjunct Professor at Imperial College Business School in London, and teaches some elective courses there on IP management, open innovation and the role of IP, as well as services innovation and IP. He graduated from NIHE Limerick (now The University of Limerick) in Ireland in 1985, with a Degree in Electronic Engineering.

Appendix 9

The final IPSC after the IPR expert workshop at Imperial College

100 Legal Service

Services involving legal or law related matters like issue of patents, preparation of patent filing documents and litigation processes.

110 IPR Protection

Process of assuring legal rights to the objects of IPR (e.g. inventions, literacy and artistic works, images, logos, designs) by filing applications with Patent & Trademark Offices and Copyright Offices.

111 Patent, Design and Trademark Search

Prior art search and investigation and comparison of existing intellectual property rights and applications regionally and worldwide.

112 Patent Drafting

Services related to the drafting of a description of the invention required for the patent application, i.e. the process of writing the patent description and claims.

113 Applications and Renewals of IPR

Applications for IPR protection and renewals of IPR protection at industrial property offices (e.g. EPO, DPMA, USPTO, JPO).

120 IPR Contracting

Services dealing with assisting with formal IPR related agreements (license agreements, co-operation agreements, co-existence agreements etc.)

121 Due Diligence

IPR related due diligence services prior to IPR transactions (e.g. licensing, acquisition, sale).

122 IPR transaction support

Negotiations for and draft of IPR contracts (e.g. licensing, acquisition, sale of IP rights), and development of legal strategies for IPR protection and use.

130 IPR Litigation

A legal proceeding in a court or a judicial contest to determine and enforce IP rights.

131 Non-judicial proceedings

Legal services lying outside the proceedings in the court (e.g. determination of possible infringement cases, negotiations for extrajudicial settlements).

132 Judicial proceedings

Legal services associated with the enforcement of IP in the court (e.g. representation in civil and criminal proceedings of IP owner or alleged infringer of IP rights).

133 Arbitration and Mediation

Legal services covering the arbitration and mediation proceedings (e.g. preparation of claims, and representation of IP owners or alleged infringer of IP rights).

140 IPR-grating

Intellectual property offices and courts that grant, re-arrange and renew legal rights to the objects of IP (EPO, DPMA, USPTO, JPO).

150 Standardization

Legal and regulatory services related to IPR standards setting.

160 Anti-Trust and Competition Law Enforcement

Services opposing or intended to regulate business monopolies, such as trusts or cartels, especially in the interest of promoting competition. Service that seeks to maintain market competition by regulating anti-competitive conduct by companies.

200 IP Consulting

Advisory services related to various IP aspects providing professional or expert advice in a particular area such as market specifics for precise industry for patenting, technology and IP roadmaps, and various analyses.

210 IP Portfolio Analysis

Services for assessment of IP rights.

211 Legal Quality Assessment

Services related to examination of the legal strength of IPR(s).

212 IPR Valuation

Determination or estimation the market value for patents or the underlying technology of trademarks, design rights or copyrights. Includes valuation of patent portfolios and technology.

213 IP Portfolio Landscaping

Assessment services that comprise mapping technology fields and existing patents according to the given patent portfolio and thus estimating its market position.

220 IP Strategy Development

Consulting services for examining the best solutions of IP usage and further development. Includes strategic planning of technology trajectories/technology paths and IP portfolio development.

230 Commercialization Support

Service that helps tech firms with converting their ideas into IPR and further into prototypes and products and bringing their products to the market by implementation of best-practice techniques.

240 Competitive Intelligence

Collection and analysis of IP related data. It is the service of defining, gathering, analyzing, and distributing intelligence about IP, IP holders, IP portfolios and any aspect of the IP environment needed to support executives and managers in making strategic IP decisions for an organization.

241 Industry Analysis

Services related to examining existing competitors and companies involved in IP market.

242 Technology Analysis

Services examining patented technologies, their technical details and – requirements for patenting purposes.

243 Patent Analysis

Services related to examining existing patents and drawing conclusions on patenting related information/activities.

250 Prior Art Search through Crowd-Sourcing Platform

Service that allows an organization or an individual to collaborate with a community to find out if specific technology exists/is patented.

260 Fighting Infringement, Counterfeiting & Piracy

Services specialized on detecting and interfering IP infringements.

261 Infringement Intelligence Service

Services for searching and demonstrating IP infringements.

262 Technical Infringement Analysis (Software / Circuits)

Services that comprise the technical detection of infringements (e.g. reverse engineering).

263 Infringement Search through Crowd-Sourcing Platform

Service that allows an organization or an individual to collaborate with a community to find out if an organization or inventor has been involved in litigations or not.

264 Collaboration with Customs

Assistance in searching and actively blocking infringed products through cooperation with customs.

265 Technology development

Services that support building technological solutions or technology developments that make it difficult to counterfeit.

270 Internationalization Support

Services for supporting internationalization and trade of IP. Includes assistance in finding investors and business partners abroad and also offering any advice in legal, strategic or politic topics for certain countries (e.g. local patent laws, local technologies and clusters, societal and environmental issues).

300 Matchmaking & Trading

Services related to arrangement of intellectual property rights related development needs of companies with available resources. Trading involving exchange of ownership.

310 Matchmaking

Service of linking IP (development) needs with available resources (including researchers).

311 Onsite Matchmaking Services

Services related to organizing desktop-based matchmaking, conferences or forums created for purpose of connecting IPR (development) needs with available resources

312 Online Matchmaking Platforms

Web-based platforms for services connecting IP (development) needs with available resources.

320 IPR Brokerage

Services related to assisting patent owners in finding licensees, buyers for their IPR. Service includes negotiating IRP related contracts, IPR purchases, - or sales in return for a fee or commission.

330 IPR Scouting

Specific services that help you to find necessary IPR. It is a team of IPR and technology experts or an expert who observes and recommends promising IPR for acquiring.

340 IPR Auction

A Service dedicated to organizing a public sale in which intellectual property or IPR portfolios are sold to the highest bidder.

341 Onsite IPR Auction

Services dedicated to providing live IPR auctions.

342 Online IPR Auction

Services dedicated to web-based IP auctions.

350 IPR Exchanges

Traded exchanges like IPXI (whether physical or online locations) similar to the NYSE and NASDAQ where yet-to-be created IPR-based financial instruments would be listed and traded much like stocks are today.

360 IPR Sharing

Services dedicated to various forms of IPR sharing.

361 Defensive Publishing

Defensive publishing or platforms where inventions are made public. Disclosing an enabling description and/or drawing of the product, apparatus or method so that it enters the public domain and becomes prior art.

362 (Online) IPR Pools for Public Use

Platforms for sharing IPR for free.

370 IPR Pooling/Aggregation

The service of scouting and acquiring existing patents for IPR portfolio establishing purposes.

371 Offensive IPR Pooling

The service of pooling of patents in order to create innovations and protect them. It includes asserting the rights against companies that would use the inventions protected by such patents (operating companies) and granting licenses to these operating companies in return for licensing fees or royalties.

372 Defensive IPR Pooling

The service of purchasing of patents or patent rights to keep such patents out of the hands of entities that would assert them against operating companies.

380 IP-driven M&A Advisory

Services similar to traditional investment banking services where a percentage fee is received. Services advising technology companies in their merger and acquisition (M&A) activities and earning fees based on the value of the entire deal (or apportioned according to the value of the IPR within the deal).

390 Purchase and Sale of IPR

Services that provide assistance with actions that involve exchange of IP ownership.

400 IP Portfolio Processing

Various services related to creation of IPR portfolios and partial management processes of the portfolio related to creating revenues out of IPR.

410 Document Processing

Services related to assisting with the documentation of patent, designs and trademark process / application itself.

411 Patent and Design Illustration

Services creating visuals to meet the requirements for filing patent, designs and trademark applications.

412 IP Translation

Services related to assistance of translations of IP documentation.

420 IP Portfolio Management

Services related to outsourcing all IP portfolio management related decision like updating the valuable patents, collecting royalties and negotiating the terms and conditions of the license agreement with potential licensees.

430 IP Portfolio Administration

Maintenance and renewal of the IP portfolios as well as collecting royalty rates and dealing with licensing.

440 IPR Augmentation

IP creation, either creating new technologies by cooperating with other institutions and as a results being the owner (or co-owner) of the patents created out of that process; or developing new technologies and getting patents on them in-house, using own R&D resources.

441 IPR Augmentation through In-house Labs

Developing IP within the institution in order to develop technologies or IP portfolios.

442 IPR Augmentation through Outsourcing

Services related to IP creation for organizations by third parties.

450 Licensing IPR

Services of licensing and advising for licensing, e.g. done by Licensing Agents. An authorization (by the licensor) to use the licensed material (by the licensee).

451 Carrot Licensing

Services executing carrot licensing involve bringing together licensing partners voluntarily. A carrot patent licensing approach is appropriate when the prospective licensee is not practicing the patented invention and is under no compulsion to take a license.

452 Stick Licensing

Services pursuing stick licensing involve to some degree infringement. A stick patent licensing approach is applied when the prospective licensee is already using your patent technology and, thereby, infringing your patent.

500 IP-related Financial Service

Services related to resource allocation as well as resource management, acquisition and investment. In other words, finance deals with matters related to capital and the markets.

510 Management of Investment Products Based on IPR

IP private equity and venture capital firms raise funds from institutional investors such as companies, banks, governments or high net worth individuals, as well as private equity fund managers themselves. Here are services dealing with resource allocation as well as resource management, acquisition and investment. Services similar to traditional venture capital (VC) or private equity firms' services, but specializing in spinning out promising non-core IP which has become stranded" within larger technology companies, or creating joint ventures between large technology companies to commercialize the technology and monetize the associated IP.

520 Management of Investment Products based on Royalty Liquidation/streams

Services related to the counsel, assistance and/or providing capital to patent owners performing IP securitization financing transactions (which resemble the more common mortgage-backed securities).

530 Financing IPR and Innovation Processes

Providing capital for IPR creation and aggregation. Includes loan based (backed by IPR) financing.

531 Private Financing

Service of providing private financing for IPR owners, either directly or as intermediaries, usually in the form of loans (debt financing), where the security for the loan is either wholly or partially IP assets (i.e., IPR collateralization).

532 Public Funding

Similarly to private funding (see 531), government funding to develop further specific technology areas or promote certain technologies.

533 PPP Financing

Similarly to private funding (see 531), composition of public and private funding for IPR creation.

540 IPR Litigation Funding

Litigation funders are providing financial means for IPR litigation and particularly patent litigation cases for a fixed fee or % on the amount gained from an infringing party.

550 IPR Insurance

Intellectual Property Insurance service protects companies for copyright, trademark or patent infringement claims arising out of the company's operation. It pays the defense costs and any judgment up to the policy limits.

551 IPR Litigation Insurance for Inventors

Insurances focused on inventors that cover legal fees for claiming and litigating own intellectual property rights. IPR coverage helps pay the legal expenses of suing an individual or firm that has violated your intellectual property rights.

552 IPR Litigation Insurance for Third-parties

Insurances that cover legal fees related to IPR litigation. Third party coverage protects you if you are sued for infringing on another party's intellectual property rights and it funds your legal defense.

600 IP-related Communication Service

Publications, journals, blogs and educational materials on IP topic as well as unions and IP interest groups.

610 IP-related Education

Services based on specialized education and coaching in IP related topics and non-academic publishers specialized on IP topics.

611-IP related Education

Services based on specialized education and coaching in IP related topics.

612-IP related Publication

(Online) Journals focusing on IPR related topics. Includes internet blogs. Excludes IP related scientific publications from 680 IP-related scientific research.

613 E-learning Solutions for IP

Internet-based education and online courses about intellectual property rights and related issues.

614 Organization and Execution of Meetings specialized on IP Topics

Gatherings or meetings for IP consultation, exchange of IP related information, or discussion, especially ones with a formal agenda on IP related topics.

615 IP-related Scientific Research

Scientific research and publications in the fields of intellectual property (mostly in an economic or legal perspective).

620 IP Software

Various gadgets and instructions and data stored electronically and created for evaluating patents and IP related features.

621 In-house IP Portfolio Management Software

Software for Managing IP Portfolio (e.g. Licensing and collecting of royalties, Application and Renewal support, IP decision management or IP portfolio related business intelligence solutions).

622 IP Portfolio Management Software for Attorneys

Specialized IP Portfolio Management software for patent attorneys.

623 IPR Valuation Software

Software that evaluates or supports valuation of patents and/or portfolios.

624 IPR Search Software

Software or web-based platforms for searching patent databases (EPO, DPMA, USPTO, JPO). Includes further examining and monitoring of patent databases and providing patent information.

625 Patent-based Public Stock Indexing

Stock indexes that are based on aggregated patent and technology value.

630 Patent Databases

Service related to organized collection of IPR related data, today typically in digital form. The data are typically organized to model relevant aspects of patents, intellectual property, and protected technology in a way that supports processes requiring patent related information.

631 Providing Patent Document Data

Services related to collecting data on patents.

632 Providing Data about IP Litigation

Services related to collecting data on IP law cases.

633 Official Design, Patent and Trademark Data provided by Industrial Property and Trademark Offices

Official design, trademark and patent databases.

640 IP-centric HR Services

Headhunting and scouting services specialized in persons in the field of intellectual property. It includes services that help to recognize outstanding inventors among other IP community members, HR recruitment platforms and conferences on IP related topics for HR people for networking purposes.

641 Matching IP Professionals and Companies through Online Platforms

Online platform posting IP expert vacancies.

642 Matching IP Professionals and Companies as HR Agency

Headhunting services for finding IP experts.

650 Interest Group, Political Work

Organizations with IPR related political or legal strategies as the main topic. Excludes associations of IP professionals.

660 Association of IP Professionals

Networks and associations of professionals with business or academic interest in IP. Includes academic research groups and bar associations. Typically, non-profit organizations.

Selbstständigkeitserklärung

Hiermit erkläre ich, die vorliegende Dissertation selbständig und ohne unzulässige fremde Hilfe, insbesondere ohne die Hilfe eines Promotionsberaters, angefertigt zu haben. Ich habe keine anderen als die angeführten Quellen und Hilfsmittel benutzt und sämtliche Textstellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen wurden, und alle Angaben, die auf mündlichen Auskünften beruhen, als solche kenntlich gemacht. Ebenfalls sind alle von anderen Personen bereitgestellten Materialien oder erbrachten Dienstleistungen als solche gekennzeichnet.

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Die vorgelegte Dissertation wurde weder im Inland noch im Ausland in gleicher oder in ähnlicher Form einer anderen Prüfungsbehörde zum Zwecke einer Promotion oder eines anderen Prüfungsverfahrens vorgelegt und insgesamt noch nicht veröffentlicht.

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