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La gestione strategica della proprietà intellettuale: come generare innovazione e difenderla. Focus sul comparto della meccanica nei mercati globali

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RIASSUNTO

Lo scopo di questa tesi è di capire se e come la gestione strategica dell'innovazione e dei brevetti viene considerata un elemento di vantaggio competitivo nell'attuale scenario economico e in quello futuro, caratterizzato da contesti globalizzati e iper-competitivi.

In questi contesti diviene fondamentale definire una chiara strategia per l'appropriazione del valore derivante dalle innovazioni, con lo scopo di sfruttare economicamente situazioni semi-monopolistiche e limitare i processi imitativi attuati dai competitors.

Partendo dal presupposto che la brevettazione ha natura strategica, specie per le imprese più innovative, e che la letteratura sul tema della valutazione dei brevetti è frammentata e non ancora univoca, si è ritenuto importante sistematizzare la letteratura accademica sul tema e sviluppare un modello strategico per la gestione dei brevetti, utile alle imprese per categorizzare i brevetti in portafoglio e decidere l'eventuale rinnovo.

Sotto il profilo metodologico è stato adottato un approccio qualitativo basato sul metodo del caso studio, realizzato prevalentemente con le tecniche dell'intervista diretta e dell'osservazione partecipante, volto ad indagare la prospettiva dell'azienda oggetto di studio appartenente al settore della meccanica di precisione.

I risultati della ricerca hanno rilevato una significativa consapevolezza di dirigenti e responsabili d'ufficio dei vari reparti, soprattutto quelli tecnici, circa il ruolo dell'innovazione e dei brevetti per la competitività dell'azienda e ha acconsentito un'analisi approfondita delle strategie innovative e di brevettazione.

Grazie alle conoscenze e alle percezioni sul tema da parte di un campione qualificato di rispondenti è stato possibile semplificare gli approcci evidenziati nella letteratura e sviluppare uno specifico modello che consente alle imprese di effettuare valutazioni in merito al rinnovo o meno dei brevetti.

La ricerca ha consentito di offrire un avanzamento scientifico, proponendo una rilettura e una sistematizzazione della letteratura sulla gestione strategica dei brevetti e un importante contributo empirico, proponendo un tool pratico a supporto delle scelte strategiche in tema di brevettazione.

Oltre ad interessanti implicazioni teoriche e manageriali, la tesi evidenzia alcuni limiti dello studio legati principalmente ad aspetti metodologici e fornisce utili suggerimenti per proseguire ed impostare i futuri sentieri di ricerca.

ABSTRACT

The purpose of this thesis is to understand if and how the strategic management of innovation and patents is considered an element of competitive advantage in the current and future economic scenarios, characterised by globalised and hyper-competitive contexts.

In these contexts, it becomes fundamental to define a clear strategy for the appropriation of the value deriving from innovations, with the aim of economically exploiting temporary semi-monopolistic situations and limiting the imitative processes implemented by competitors.

Starting from the assumption that patenting has a strategic nature, especially for the most innovative companies, and that literature on patent value is fragmented and not yet univocal, it was considered important to systematise the academic literature on the topic and develop a strategic patent management model, useful for companies to categorise patents in their portfolio and decide on possible renewal.

From a methodological point of view, a qualitative approach was adopted, based on the case study method, carried out mainly with the direct interview and participant observation techniques, aimed at investigating the perspective of the company being studied, belonging to the precision mechanic's sector.

The results of the research revealed the awareness of managers and office managers from the various departments, especially technical ones, regarding the role of innovation and patents for the competitiveness of the company and allowed an in-depth analysis of the innovative strategies and of patenting.

Thanks to the knowledge and perceptions on the topic of a qualified sample of respondents, it was possible to simplify the approaches highlighted in the literature and develop a specific model that allows companies in the sector to carry out assessments regarding whether patents should be renewed or not.

The research therefore made it possible to offer scientific advancement by proposing a new interpretation and systematisation of the literature on the strategic management of patents, and an important empirical contribution by proposing a practical tool to support strategic choices regarding patenting.

In addition to interesting theoretical and managerial implications, the thesis highlights some limitations of the study, mainly linked to methodological aspects and provides useful suggestions for continuing and setting future research paths.

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INTRODUCTION

Patents are Intellectual Property Rights (IPRs) that protect innovations from threats of imitation by competitors and are recognized as intangible assets that are important for the performance and value of companies.

The choice between patenting and secrecy, the definition of a specific patent strategy for each patent, the strategic management of the patent portfolio and the evaluation of individual patents are just some of the issues inherent to intellectual property that should concern all innovative companies, without distinction of sector and size, especially those that operate in more globalized and hyper-competitive contexts.

The management of patents should take place from the strategic perspective of appropriating the value deriving from technological innovations, avoiding the efforts of the innovative process being wasted and competitors taking advantage of them, or from a perspective of commercial exploitation from a semi-monopolistic situation that Patents guarantee legal protection in the event of infringement.

If on the one hand, however, small-sized companies suffer in the generation of innovations due to a lack of economic availability and/or skills and resort to open innovation processes (Piccaluga, 2020), on the other hand, medium-large sized companies do not they always have a specific Intellectual Property (IP) department and rarely adopt a strategic approach to patent management (Di Minin, Fisher and Oberholzer-Gee, 2013, Somaya, 2012).

The topic of the strategic management of patents through evaluation was thus chosen as the main object of study of the thesis in light of the important strategic role that they play for companies operating in various sectors, especially technologically advanced ones.

Patents, being subject to sales and licensing decisions, require monitoring by the companies that own them and, therefore, knowledge of their characteristics and their evaluation is necessary, in order to allow a more aware operational and strategic management.

From research conducted on selected sources (search engines and databases) relating to the topic of patent evaluation, it emerged that some authors (Grimaldi and Cricelli, 2020, Girgin Kalip *et al.*, 2022) have highlighted the existence of literature in this highly fragmented subject and the importance of systematically ordering studies on the topic.

Furthermore, it emerged that the majority of publications on the subject generally deal with aggregate data rather than individual data at the "level of individual companies" (Pitkethly 2006), i.e. adopting

an inter-sectoral macroeconomic investigation perspective rather than a microeconomic one (i.e. corporate) and therefore recording a lack of corporate case studies.

To the best of our knowledge, therefore, there are few contributions that highlight the evolutionary path of the different patent evaluation methodologies and few studies allow their application in corporate contexts.

This doctoral thesis contributes to filling these research gaps. In particular, the thesis was carried out within the 35th Cycle of the PhD (Philosophiae Doctor) in "Global Studies, Economy, Society and Law", as part of the Eureka Project - PhD scholarships for innovation. This Project involves the active participation of the Marche Region, the University of Urbino "Carlo Bo" and companies from the Marche region that host the research projects. In this specific case, the company hosting the research project from which the doctoral thesis was developed is "Benelli Armi S.p.A. (Società per Azioni)".

More precisely, the Eureka Project is an intervention that the Marche Region is carrying out as part of the POR (Programma Operativo Regionale) Marche FSE (Fondo Sociale Europeo) 2014/2020, in order to broaden the skills of young graduates and strengthen their employment potential, by means of a research doctorate.

Benelli Armi S.p.A, which represents the main object of study, operates in the production of semi-automatic repeating weapons and ammunition within the macro-sector of precision mechanics, and is based in Urbino in province of Pesaro-Urbino (PU).

In particular, during the thesis, a historical analysis of the company will be provided, also in terms of numbers that decree its undoubted success and strategies. Operational processes relating to innovation and patenting will be described.

In line with the industrial characteristic of this type of PhD project, the general objectives of the study have both an "academic" and an "empirical" nature and consist, specifically, in filling a gap in scientific knowledge on the topic of the evaluation of patents in corporate contexts and in satisfying the knowledge requirements of company management regarding the importance of innovation and patenting for competitive purposes and in developing a model to satisfy the need for strategic management of company patents.

The following research questions were therefore defined:

- ✓ *RQ1- How is managerial economic literature evolving on the topic of patent value?*
- ✓ *RQ2- What are the main characteristics of the conceptual models used for patent evaluation in corporate contexts?*
- ✓ *RQ3- What role do innovation and patenting play for competitive purposes in the arms sector?*
- ✓ *RQ4- What are the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts?*

With the aim of answering these research questions, specific research methodologies and techniques have been defined.

To answer the first research question, the evolutionary path of studies relating to the topic of "patent value" was analysed and a decision was taken to carry out a systematic review of literature (Tranfield *et al.*, 2003; Pittaway *et al.*, 2004), namely, to systematically organise the fragmented literature on thise topic, in order to offer scholars, policy makers and professionals in the sector a complete vision of the state of the art.

Furthermore, by answering the second research question, through an analysis of the prevailing literature on the topic of strategies and management of individual patents in corporate contexts, we wanted to propose a conceptual summary scheme that could be used for the strategic management of patents in corporate contexts and we wanted to highlight the characteristics of the different patent evaluation approaches/models.

Finally, it was decided to proceed with the creation of the single company case study, which allows us to investigate the object of the study in depth (Piekkari *et al.*, 2009) and guarantees the richness of the results (Dubois and Gadde, 2002). However, it reduces the possibility of generalising the results and increases observer bias (Vissak, 2010).

The industrial nature of the PhD project "imposes" the co-financing company as the main object of study, although some authors (Eisenhardt and Graebner, 2007) suggest intentional rather than random qualitative samples and the use of multiple case studies.

Despite this, Benelli Armi S.p.A. lends itself to a single case study for a series of reasons, which will be explored in depth during the thesis:

1) the *relevance and exceptional nature of the company in the sector, i.e. its innovative capacity*, through which it aims to be always ahead and on which it bases its competitiveness;

2) the *patent portfolio*, to protect technical innovations;

3) the *exploratory nature of the study* to fill large gaps in the literature;

4) the *access to company data* despite the sensitivity of the study.

Therefore, the aforementioned company case study offers a good opportunity to address the issues previously exposed, investigating the context and the company reality, and thus answer the third and fourth research questions.

In particular, the case study was carried out using different investigation techniques for the purpose of data collection and analysis: they consist primarily of participant observation and the conduct of in-depth personal interviews, conducted with selected respondents based on semi-structured questionnaires, specifically drawn up to be able to develop a specific model for the evaluation of patents, but also in the use of additional data such as website and company documentation and databases.

Qualitative research guarantees "the privilege granted to close observation and the commitment to modelling one's data construction and analysis procedures on the characteristics of the object" (Cardano, 2011) and was primarily embodied in the observation technique participant. This technique consists of "a research strategy in which the researcher inserts himself a) directly and b) for a relatively long period of time in a specific social group c) taken in his natural environment, d) establishing a relationship of personal interaction with its members e) with the aim of describing their actions and understanding, through a process of identification, their motivations" (Corbetta, 1999).

The researcher has experienced a three-year period in the company's Product Development Department as a participant observer, i.e. the constant physical presence in the workplace was guaranteed, interacting with some of the people involved in the study during their working day.

This methodological technique was one of the main methods of investigation, although it was affected by the limitations imposed by compliance with the rules during the Covid-19 pandemic, such as the Work From Home (WFH) mode and the impossibility of participating in trade fair events.

The three-year period has, in fact, allowed data and information to be collected over a long period of time, allowing social actions and interactions to be understood at a functional and operational level. However, it immediately emerged that simple observations would not be sufficient to fully understand the topics under study.

The reconstruction of the generation processes of the different types of corporate innovations (essentially product, process and organisational) and of the patent generation processes, the understanding of management's perceptions regarding the importance of innovation and patenting in the sector to which they belong, and the analysis of the problems regarding identification of strategic and non-strategic company patents specifically required in-depth analyses.

The comparison between what emerged from the analysis of international literature on the topic of the evaluation of individual patents and their strategies and management with the data and information collected during the time spent as a participant observer within the Product Development Department at Benelli Armi S.p.A. was therefore the basis for the drafting of two different semi-structured questionnaires.

In this regard, questions were defined, with closed/standardised responses, where evaluation is based on scales from 1 to 5 or in percentage terms, and with open/free responses.

Since the objective was to carry out an in-depth analysis of innovation and patenting at company level, the possibility of conducting direct interviews with selected company respondents was requested, and subsequently granted, administering the questionnaires and providing support to the interviewees.

In fact, alongside participant observation in the workplace, the most widespread and used research knowledge method in the world of social sciences is asking questions (or interviews) and consists of "an interview with one or more subjects, specifically selected, so that they respond to a series of questions, previously set by the researcher, with the aim of knowing the interviewee's thoughts regarding those themes that the researcher has identified as the object of his research" (Natale, 2007).

It was thus decided to carry out ten interviews, each of which lasting approximately two hours and based on one or both of the semi-structured questionnaires that had been created and administered, depending on the specific competence of each respondent (technical, commercial or both).

Further data, collected from websites, financial statements, archival documentation and company publications, allowed the cross-checking of statements made in interviews through triangulation (Woodside and Wilson, 2003), and revealed a high level of coherence.

In light of the above, it was decided to structure the thesis as follows.

- Chapter 1 presents a systematic review of literature on the subject of patent value, that systematically organises the fragmented literature, offering a complete vision of the state of the art on the topics of interest, adopting the unit of analysis used in the study as criteria for the categorisation of the publications, i.e. studies conducted with aggregate data from a cross-sector macroeconomic survey perspective and studies conducted with individual data from a corporate microeconomic survey perspective, and the methodology adopted.

- Chapter 2 presents a conceptual summary scheme, the result of the analysis of the prevailing literature on the topic of strategies and management of individual patents, useful for companies to understand, in general terms, the advantages and disadvantages deriving from patenting and secrecy, understanding and explaining patent strategies, i.e. the strategic objectives that you want to achieve with each individual patent and highlighting the main patent evaluation models that can be applied in corporate contexts.

- Chapter 3 presents the company case study, Benelli Armi S.p.A., illustrating the reasons that led to the adoption of this research methodology and describing the investigation techniques: participant observation, personal interviews based on semi-structured questionnaires , and the analysis of further data such as website and company documentation and databases; the company that is the subject of the case study is also presented, through an analysis of its history, organisational structure and corporate strategy, in terms of vision, mission and corporate values.

- Chapter 4 describes the approach to innovation and patenting in the company, which declares itself an innovation leader in the sector also at international level, with the aim of highlighting the way in which innovation and patenting strategies are planned, developed and implemented at different levels: corporate, business and functional. An analysis of the roles, activities, resources and timing is thus presented, which allow us to arrive at innovations and patents in the company.

- Chapter 5 investigates the main success factors of the arms sector in order to understand managerial perceptions of the importance of innovation and patenting for competitive purposes; an interpretation of the respondents' knowledge and perceptions on patent strategies and management is also proposed in order to identify the most important criteria for the definition of a specific multi-criteria decision-making model for the qualitative evaluation of patents for the purposes of their renewal.

- Chapter 6 presents and illustrates the developed model that allows an evaluation of the opportunity of renewing patents in different countries, where patent protection is extensive and where there are different competitive positionings and different product sales volumes. Furthermore, application of the model that allows the categorisation of company patents into strategic and non-strategic is presented, together with a critical analysis of the results and proposals regarding patents not to be renewed and a discussion of the entire case study.

Finally, an overall discussion of the results and limitations of the study is proposed, highlighting theoretical implications, managerial implications and ideas for future research.

SECTION 1

Innovation and Patenting

CHAPTER 1- A systematic literature review on the methodologies for assessing patent value

CHAPTER 2- Strategic patent management in corporate contexts: a summary of the literature

CHAPTER 1

A systematic literature review on the methodologies for assessing patent value

Introduction

The objective of this chapter is to answer Research Question 1 (RQ1), reported in the Introduction to the doctoral thesis and referred to below:

- ✓ *RQ1- How is managerial economic literature evolving on the topic of patent value?*

The use of "patent statistics" in economic-managerial literature as economic indicators and, in particular, as performance indicators of inventive-innovative activities, is not new and dates back to the 1980s and 1990s.

Patents, the Intellectual Property Rights (IPRs) that specifically protect innovations against the threats of imitation by competitors, are recognised as intangible assets important for the performance and value of the companies and, over the last few decades, play a strategic role in many fields of the business, being most of them subject to sales and licensing decisions or to an internal management.

At the same time, the simple counts of patents themselves cannot be considered sufficiently informative about the quality of the innovative outputs, meaning the set of new products and processes developed in companies, centres of research and Universities, because not all innovations are linked to the filing of patents. Furthermore, the importance of innovative outputs varies considerably in relation to the value that can be attributed to them and this also applies to patents.

Numerous scientific contributions about "patent value" topic have been examined from different perspectives of analysis that are characterised by different research designs based on the use of different variables, models and samples.

Most publications provide econometric methods of patent valuation, generally dealing with aggregate patent values rather than individual patent values.

This chapter describes a literature review on the different methodologies used to analyse the value of patents, starting from the pioneering studies on the topic, with the scopes of highlighting research trends and the main research lines while adopting different perspectives of analysis.

These studies, containing the first econometric models dating back to the 1980s, are divided herein into two areas of application: the contributions that deal with aggregate values (the macroeconomic/sectoral perspective), and the ones that focus on individual values (the microeconomic/corporate perspective).

In answering these questions, this chapter seeks to organise a fragmentated literature systematically, thus providing scholars, policymakers, and business practitioners with a comprehensive view of the state of the art. Indeed, some authors of the literature (see, among others, Grimaldi and Cricelli, 2020, Girgin Kalip *et al.*, 2022) have already noted the importance of such a systematic ordering of frames of thought concerning the evaluation of patent value, herein organised in terms of trends in the study of topics and aggregate/individual unit of analysis.

Moreover, this theoretical approach can help to highlight the necessity of specific attention to the microeconomic perspective.

In particular, the chapter allows the following objectives to be pursued:

(i) highlighting the temporal trends in the study of patent value;

(ii) highlighting the main research lines and methodologies adopted to evaluate patent, using as criteria for analysis and categorisation of the selected publications, the survey perspective and the methodology employed.

The paper is structured as follows:

(i) the first paragraph illustrates the topics of interest, highlighting the lines of study identified by the main authors concerning different research designs implemented (the state of the art);

(ii) the second paragraph describes the research methodology adopted for the collection of scientific papers;

(iii) the third paragraph illustrates the systemisation and the timeline of the result-articles;

(iv) the fourth paragraph illustrates the selection criteria of the scientific papers used for writing the literature review;

(v) the fifth paragraph illustrates the systemisation and the timeline of selected articles as a sample;

(vi) the sixth paragraph proposes a classification of the sample articles, based on the criterion of the survey perspective, macroeconomic/sectoral and microeconomic/corporate, and proposes the literature review of the selected papers, identifying the main lines of study, using the "methodology used" as a criterion.

Finally, a schematic and critical analysis of what emerged from the review of the literature is provided and summary observations are set out.

1. The state of the art on the topic of patent value

Over the last few decades, the rapid development of technological innovations and the even more rapid spread thereof have favoured the unification of markets worldwide, accelerating the phenomenon of globalisation.

Globalisation is a phenomenon that represents a boost to technological innovation, since it opens up opportunities for the contamination and integration of knowledge between companies and between companies and institutions.

Sometimes it is also a consequence, since innovations, especially in the information and communication sectors, contribute to the creation of a world where individuals and businesses are increasingly close and connected.

Furthermore, globalisation increases threats of imitation by global and multinational competitors and these threats become increasingly dangerous in international markets, where innovation is a critical success factor for companies and entire nations' competitiveness.

The greater need for the protection of innovations has, therefore, emerged and it is possible to satisfy this need through specific titles, patents, which are IPRs that specifically protect innovations against the threats of imitation. Patents guarantee a semi-monopolistic position to the innovator thus allowing the commercial exploitation of their innovation.

A patent is an intellectual property right guaranteed by a sovereign state (therefore, a territorial area limited by geographical borders) for an inventor for a limited period of 20 years, which cannot be

renewed or extended. To our knowledge, this "standard" duration is shared in various countries of the world in the main areas.

In exchange, patent protection requires a public and detailed disclosure of the characteristics of the invention. This invention must be new, not obvious, unique in relation to the prior art (i.e., the state of the art up to that moment) and capable of industrial application (i.e., configured as an innovation).

Patents play a strategic role in many fields of business, with most of them subject to sales and licensing decisions or requiring internal management; these decisions have become strategic over the last few decades, wherein these intangible assets are recognised as important for the performance and value of the companies.

Over time, the use of "patent statistics" in economic-managerial literature as economic indicators have thus gained popularity and, in particular, the use of these statistics as indicators of the performance of inventive-innovative activities (Griliches *et al.*, 1986). This dates back to the 1980s and 1990s (for a comprehensive survey on the subject see Griliches, 1990).

At the same time, the simple counts of patents themselves cannot be considered sufficiently informative about the quality of the innovative outputs, meaning the set of new products and processes developed in companies, centres of research and Universities, because not all innovations are linked to the filing of patents. Furthermore, the importance of innovative outputs varies considerably in relation to the value that can be attributed to them and this also applies to patents.

In this sense, numerous academic and scientific contributions have investigated the topic of "patent value" from different perspectives of analysis.

On the one hand, economists and policy makers are interested in innovations, patents and their (aggregate) value since they are considered to be critical success factors, fundamental for the competitive advantages of entire nations; on the other, accountants and business strategists are interested in the evaluation of (individual) patents, for example, for correct registration in financial statements, or for the purchase and sale of such assets or for a more informed management of the patent portfolio.

It was possible to trace numerous contributions on the topic of "patent value" characterised by different research designs based on the use of different variables, models and samples.

There are many different research designs (Figure 1.1), as there are also many studies which differ in relation (Sapsalis and van Pottelsberghe de la Potterie, 2007):

- to the definition of the dependent variable and of the independent variable(s):

    - the dependent variable can be the monetary value of the patent (Harhoff *et al.*, 1999, 2003), a value discounted by experts through large-scale surveys (Reitzig, 2003), a composite quality indicator (Lanjouw and Schankerman , 1999), data relating to the patent opposition and data relating to renewal (Pakes and Schankerman, 1984; Pakes, 1986; Pakes and Simpson, 1989, Lanjouw and Schankerman, 1997), the probability of obtaining patent protection (Guellec and van Pottelsberghe, 2000) or the number of Forward Patent Citations (FPCs) of the patent (Lerner, 1994);

    - the independent variable(s) tested can be correlated (positively or negatively) or not correlated to the value of the patent and are considered "determinants" (or not) of the value; independent variables may be the number of FPCs, the number of Backward Patent Citations (BPCs), the geographical scope of protection (that is the number of countries that fall within the patent family), the opposition procedures, the data on renewals, scope (number of claims) and number of Non-Patent literature Citations (NPCs).

      Thus, some independent variables in certain studies become dependent variable in others. For example, the FPCs variable, which is at the same time the most tested determinant in almost all the studies mentioned above, can sometimes be the dependent variable, which approximates the value of the patent, a correlation with other determinants such as the family size and the time (Lerner, 1994);

- to the type of estimated model, which can be stochastic, probit, Ordinary Least Squares (OLS);

- to the sample of used patents: the studies differ in the size of the sample used and in the fact that they rely on different datasets relating to patents, including cross-sectoral or different countries or different time-lapses (for example, all patent applications in a regional office, a particular sector, a sample of firms in a given country).

Figure 1.1- Overview on patent value topic

TABLE II Determinants of patent value (part 1).

	Patent Value		*Patenting Procedure*					*Patent characteristics*									*Others*
Authors	*PV*	*QI*	*OP*	*AP*	*GP*	*RP*	*FC*	*FPC*	*BPC*	*NPC*	*Claim*	*Scope*	*Size*	*IPC. Class*	*Time*	*Owner char.*	*Others*
Schankerman and Pakes (1986)						D°											
Lerner (1994)								D				+			+		
Lanjouw and Schankerman (1997)			D					+	+		+	−				+	*
Lanjouw (1998)						D°											
Harhoff *et al.* (1999)	+							D						*			
Lanjouw and Schankerman (1999)		D						+	+		+		+	*			
Lanjouw and Schankerman (1999)						D		+	/		/		+	*			
Lanjouw and Schankerman (1999)			D					+	/		+		+	*			
Guellec, van Pottelsberghe (2000, 2002)					D							−	+		+	+	+
Shane (2001)							D	+				+		*	+		*
Harhoff and Reitzig (2002)			D					+	/	/		−	+	*		*	*
Harhoff *et al.* (2003)	D		+	+				+	+	+		/	+				
Reitzig (2003)	D°°														+		*
Conclusions	+		+	+				+	(+)	(+)	+	(+/−)	+	*	+	*	*

PV: Monetary Patent Value or Net Present Patent value; QI: quality index; OP: opposition/ litigation procedure; AP annulment procedure; RP: Renewal data; GP: Granting of patent application; FC: Firm creation. The signs are D: Dependent variable; +: Positive and significant impact; −: Negative and significant impact; /:No significant impact. *:The variable description hides a set of manifold variables. Among those, some have a positive or a negative impact and others have no significant impact °:Model of patent renewal decision is constructed around the following variables: legal fees, renewal fees, annual return and expected future value. °°: The model relies on variables like the importance of the patent for current and future technical developments; the difficulty to invent around the patent and to prove its infringement; the learning value for competitors, the number of competitor and the fact that the patent is the basis for other ones. These variables have been evaluated by experts on Likert scales.

Source: Sapsalis and van Pottelsberghe de la Potterie, 2007.

As noted by Pitkethly (2006), however, most publications that provide econometric methods of patent valuation generally deal with aggregate values rather than single patent values. Among the above-mentioned contributions, only one (Reitzig, 2003) deals with the evaluation of individual patents of a semiconductor company. In this study, patents were evaluated comprehensively by technical and marketing representatives. This occurs because the information that can be obtained in public databases is more easily available than sensitive and confidential data that could be collected in field investigations.

At the current state of the art, it is possible to trace contributions that divide the studies on the "patent value" into different strands, especially as regards the results deriving from the application of the various theoretical models developed. However, to the best of our knowledge, there have been fewer contributions that highlight the evolutionary path of patent value topic from 1980s onwards, relating to the identification of the different methodologies used for analysing the value of a patent.

This chapter provides a literature review on the different methodologies used to analyse the value of patents, starting from the pioneering studies on the topic, with the scopes of highlighting the research trends and the main research lines adopting different perspectives of analysis.

These studies, containing the first econometric models dating back to the 1980s, are divided herein into two areas of application: the contributions that deal with aggregate values (the macroeconomic/sectoral perspective), and those that focus on individual values (the microeconomic/corporate perspective).

2. Research method

The methodology followed for the literature review is shown in this section. To identify and compare the main patent evaluation frameworks proposed by patent value literature, the systematic literature review (Tranfield *et al.*, 2003; Pittaway *et al.*, 2004) was chosen as the research methodology.

Results are presented based on Preferred Reporting Items for Systematic reviews and Meta-Analyses, PRISMA (Page *et al.*, 2021), a framework used for systematic reviews that supports authors in developing their reviews and meta-analyses, highlighting the inclusion and exclusion criteria, allocated in relevant phases of the PRISMA flow chart and graphically adapted by the authors in order to highlight those adopted.

In order to provide a review of the main patent value evaluation methodologies, this study focuses on the different methods/models used for measuring the patent value in the selected publications, categorised according to certain criteria (aggregate values/individual values and specific methodologies adopted).

The methodology followed for the collection and selection of the studies subject to systematic literature review is articulated and personalised in the phases specified below, in order to propose categorisations of the publications identified and, subsequently, selected.

As regards the collection of scientific papers, two sources have been chosen, which collect a wide range of publications in accredited journals: Google Scholar search engine and Scopus database. To evaluate the adequacy of these sources for researching academic articles, their advantages but also disadvantages were analysed (see Jacsó, 2008; Falagas *et al.*, 2008).

The keywords used in the research of the publications are the result of a preliminary and informal research in the selected sources, in order to identify the most frequently used words in the field of "patent value" and which return the most results.

The collection of scientific articles began immediately in the Google Scholar search engine, by typing the string of keywords "Patent value" through an advanced search, that is, using the logical "AND" operator, since the search for single words returns millions of results.

The string was searched throughout the article and, given the large number of items in the order of hundreds of thousands, subsequently only in the title of the publications.

The collection of scientific articles continued using the Scopus database. The search was immediately more focused since the keywords were searched not in the entire article but in the title, abstract and keywords; at the same time, however, the search took place, always using the logical operator "AND", not as strings of keywords but as single words and this again entailed the return of a large number of items, of thousands of articles, not as many as on Google Scholar, but still difficult to manage.

Since the goal was to obtain results that are as targeted as possible with the purposes, the research proceeded with such keywords as strings and this always occurred in the title, abstract and keywords, although in some cases the contributions were not relevant to the research objectives.

The results of this process of refinement of search of keywords are summarised below (Table 1.1).

Table 1.1- Google Scholar and Scopus results

Source	**Google Scholar**	Source	**Scopus**
Results for "Keywords" throughout the article (*"Patent value"*)	7250	Results for Keywords throughout Title-Abstract-Keywords (*Patent AND Value*)	11770
Results for allintitle: "Keywords" (*allintitle: "Patent value"*)	420	Results for "Keywords" throughout Title-Abstract-Keywords (*"Patent value"*)	275
Duplicate Publications	50	Duplicate Publications	3
Non-Duplicate Publications	**370**	Non-Duplicate Publications	**272**
Total Publications 642			

Source: personal elaboration.

It appears that with both Google Scholar and with Scopus, "Patent value" is the string of keywords that exhaustively summarises the meaning of the search, returning a great number of results. This also

happens through more refined and less dispersive advanced research (i.e., keyword strings researched only in the title of the publication, in the case of Google Scholar and in the title, abstracts and keywords, in the case of Scopus).

Some terms such as “assessing”, “indicator”, “measure”, “method”, “metric” and “model” have been used to integrate the research with further articles; however, the further specification of the keywords did not enrich the picture that emerged initially, given the small number of articles relating to the topics of interest obtained, most of them duplicates, through advanced research.

3. Systematisation of publications

In this paragraph, a classification and a timeline of the publications collected through Google Scholar and Scopus are proposed. This classification allows a distinction between publications published in the ANVUR accredited scientific journal, online or presented at conferences/workshops or published as a book or chapter of a book or e-book

ANVUR is the acronym that identifies the “Agenzia Nazionale per la Valutazione del Sistema Universitario della Ricerca”, namely the National Agency for the Evaluation of the University Research System in Italy. The Organisation prepares and periodically updates lists of journals which, on the basis of appropriate criteria, are considered “scientific journals” useful for the evaluation of scholars’ research products for the purpose of calculating the indicators of the National Scientific Qualification starting from 2012 and for the purposes of accrediting PhD courses.

While aware that the classification is aimed at evaluating the research carried out by Italian scholars and that like all classifications, it can be incomplete, we have chosen to make this distinction also to highlight how much the “Patent Value” theme was considered by the ANVUR-accredited journals compared to journals not classified as scientific.

Google Scholar

Of the 420 articles collected, 58 were duplicates. The remaining 370 were divided and counted into articles:

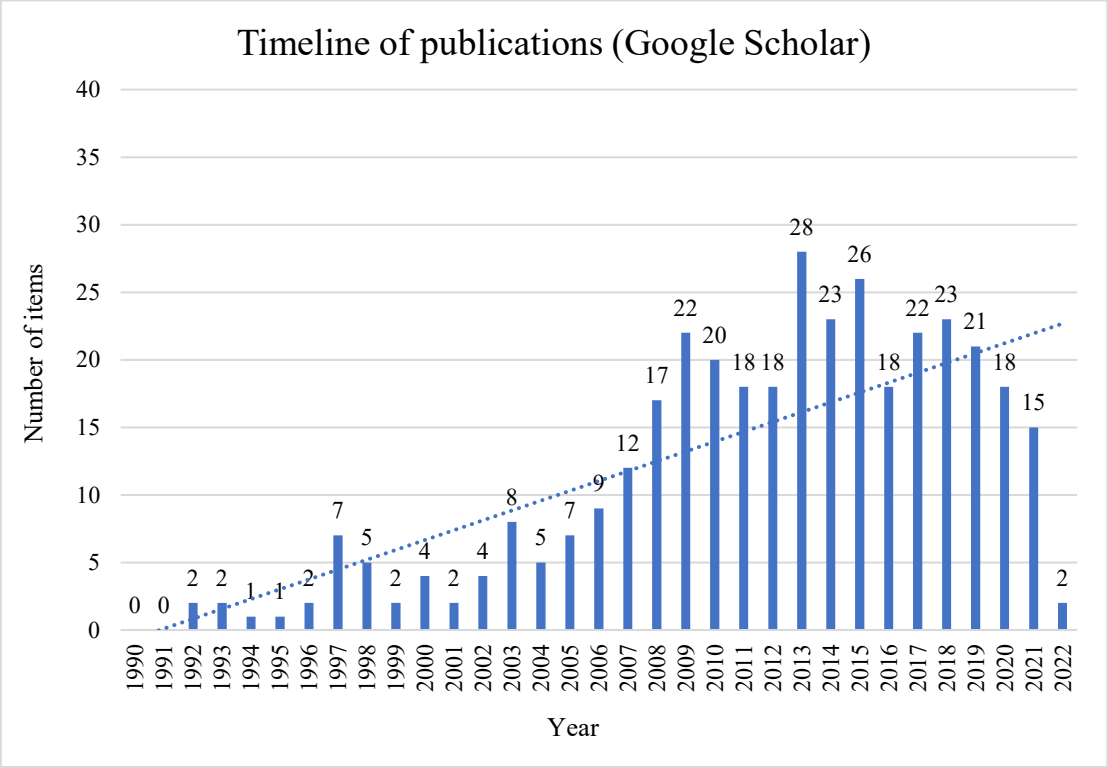
- published in an ANVUR-accredited scientific journal: 96;
- published in non-ANVUR accredited scientific journal: 57;
- published exclusively online (databases and online libraries, company reports, university working papers, theses): 72;
- presented at a conference/workshop: 37;
- published as a book or chapter of a book or e-book: 10;
- referred to by simple quotation; this work is not present in the list of results since, otherwise, it has already been counted among the duplicates: 98.

Further, we proceed with the same distinction, in the categories listed above:

i. Citation to articles published in ANVUR-accredited journal: 4;
ii. Citation to articles published in non-ANVUR accredited journal: 43;
iii. Citation to articles published exclusively online: 33;
iv. Citation to a conference paper: 16;
v. Citation to a book or chapter of a book or e-book: 2.

As regards the timeline of publication of the results, 6 articles were excluded from the processing of the 370 articles, 4 of which in the form of citations. Indeed, they did not have complete information and, despite subsequent searches, it was not possible to trace the date of publication (website not found or blocked). In total, therefore, 364 articles were considered. The first traced articles date back to the nineties, in particular to 1992. The following is the timeline of publications since 1990 of the 364 articles collected using the Google Scholar database (Figure 1.2); each column indicates the number of articles collected per year.

Figure 1.2- Timeline of publications (Google Scholar)



Source: personal elaboration.

The graph shows an overall growing trend in publications, with a surge between 2010 and 2015 but decreasing in recent years; Google Scholar usually contains metadata from cited papers and therefore more recent works are often even less cited.

Scopus

Of the 275 articles collected, 3 were duplicated. The remaining 272 were divided and counted into articles:

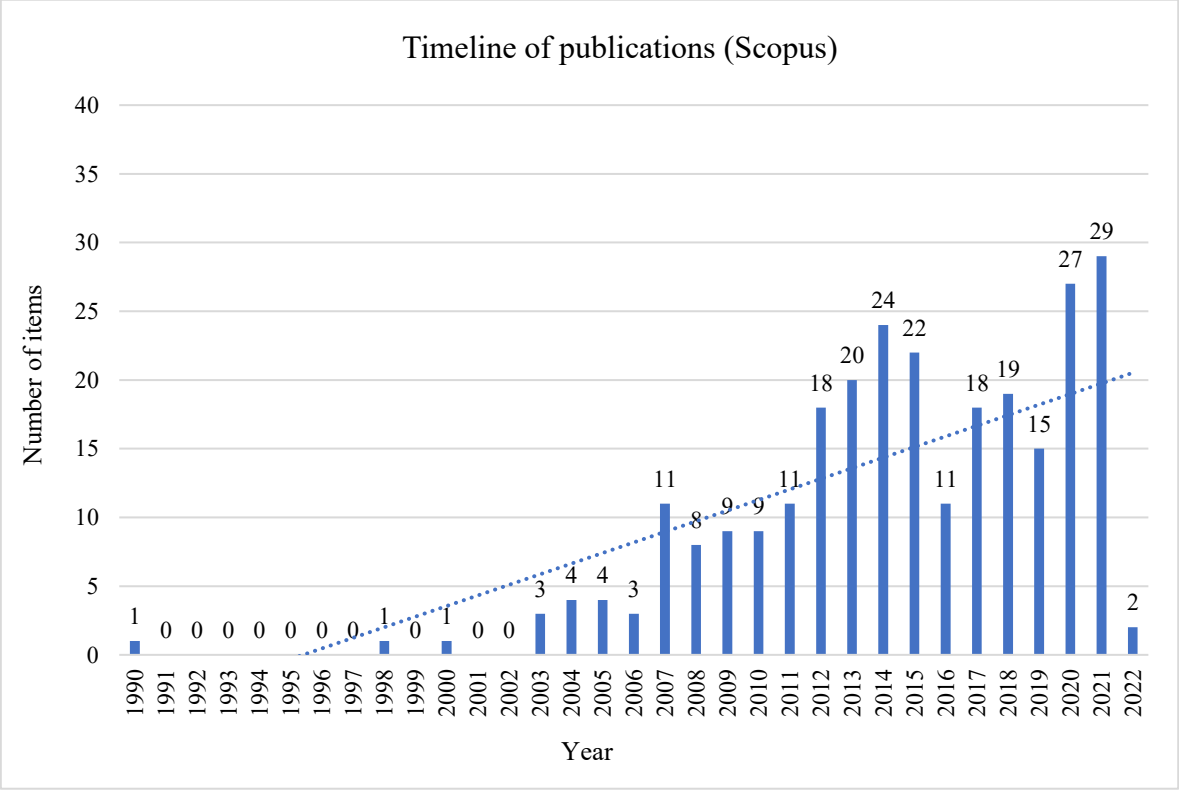
- published in an ANVUR-accredited scientific journal: 161;
- published in a non-ANVUR accredited scientific journal ANVUR: 56;
- published exclusively online (databases and online libraries, company reports, university working papers, theses): 1;
- presented at a conference/workshop: 49;

- published as a book or chapter of a book or e-book: 5;
- referred to by simple quotation; this work is not present in the list of results since, otherwise, it has already been counted among the duplicates: 0; citations are not returned in the results of searches carried out with Scopus.

As regards the timeline of publication of the results, no article was excluded from the processing, since the relative information is complete (title, author, year, type of publication and number of citations received).

The first traced articles date back to 1971 and 1987 (excluded, however, for convenience from Graph 2 as they are temporally distant from the other articles collected); in fact, the publications collected date back to the nineties; in particular, the timeline of publications of 270 articles collected with the Scopus database is provided below (Figure 1.3); each column indicates the number of articles collected per year.

Figure 1.3 - Timeline of publications (Scopus)



Source: personal elaboration.

The graph shows an overall growing trend in publications, with a surge starting in 2010; the increase in publications is recorded above all in the last years of 2020 and 2021, unlike what emerged through Google Scholar as Scopus catalogues all public contributions, regardless of citations.

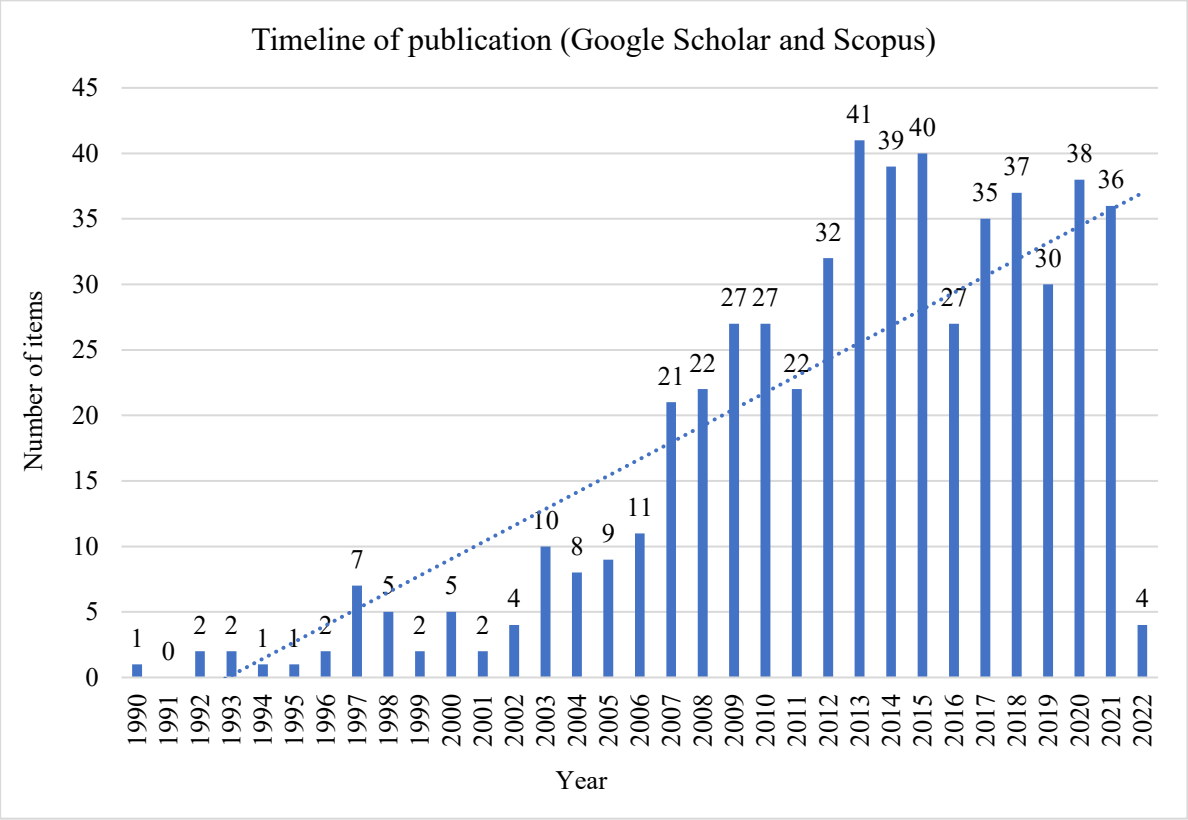
Google Scholar and Scopus

From the 695 articles collected, 53 duplicates were eliminated (as the sum of 50 found in Google Scholar and 3 found in Scopus) as well as a further 84 articles that are repeated between the two databases, thus obtaining a final database of 558 articles. Below, is the classification of all 558 publications collected jointly in the two databases, divided and counted into articles:

- published in an ANVUR-accredited scientific journal: 198;
- published in a non-ANVUR accredited scientific journal: 102;
- published exclusively online (databases and online libraries, company reports, university working papers, theses): 73;
- presented at a conference/workshop: 72;
- published as a book or a chapter of a book or e-book: 15;
- referred to by simple quotation; this work is not present in the list of results since, otherwise, it has already been counted among the duplicates: 98 (the distinction has the same values as Google Scholar since in Scopus the citations are null):
    i. Citation to articles published in an ANVUR-accredited journal: 4;
    ii. Citation to articles published in a non-ANVUR accredited journal: 43;
    iii. Citation to articles published exclusively online: 33;
    iv. Citation to a conference paper: 16;
    v. Citation to a book or a chapter of book or e-book: 2.

As regards the timeline of publication of the results, 6 articles collected with Google Scholar were excluded from the processing, those that did not have complete information (website not found or blocked). In total, therefore, we have 552 articles. The first articles were traced back to 1971 and 1973 (excluded, however, for convenience from Figure 1.4 as they are temporally distant from the other articles collected). The timeline of publications of 550 of all the publications available with complete information is proposed below; each column indicates the number of articles collected per year.

Figure 1.4- Timeline of publications (Google Scholar and Scopus)



Source: personal elaboration.

The analysis conducted allowed the trends over time in the study of issues relating to the evaluation of patents to be highlighted. There is an overall growing trend in publications, with a surge between 2010 and 2015 and still growing in recent years. The issue of measuring the value of patents has therefore received increasing attention from the scientific community; more than half of the publications took place in a scientific journal and 2/3 of these in an ANVUR-accredited scientific journal. The collected works belong to the economic area (specifically managerial, accounting, econometrics and finance) and in the pharmaceutical and biotechnology area, given the importance of patents in these sectors, both in accredited journals and on databases and online libraries.

4. Selection of the sample

In this paragraph, a classification and the timeline of the selected publications, representing the sample of our literature review, are proposed. A total of 740 articles were identified, as result of the 695 publications obtained by typing the keywords on the Google Scholar search engine and on Scopus database, jointly with 45 publications collected through manual research focused on the

bibliographies of the articles reached by keywords. In particular, based on the screening of 558 studies (420 traced with the Google Scholar search engine and 275 with the Scopus database, net of 137 duplicates), the bibliographic references were retraced in order to acquire the most influential and essential ones in the field of patent value, i.e. the most cited, pioneering and, at the same time, relevant to the purposes of the research.

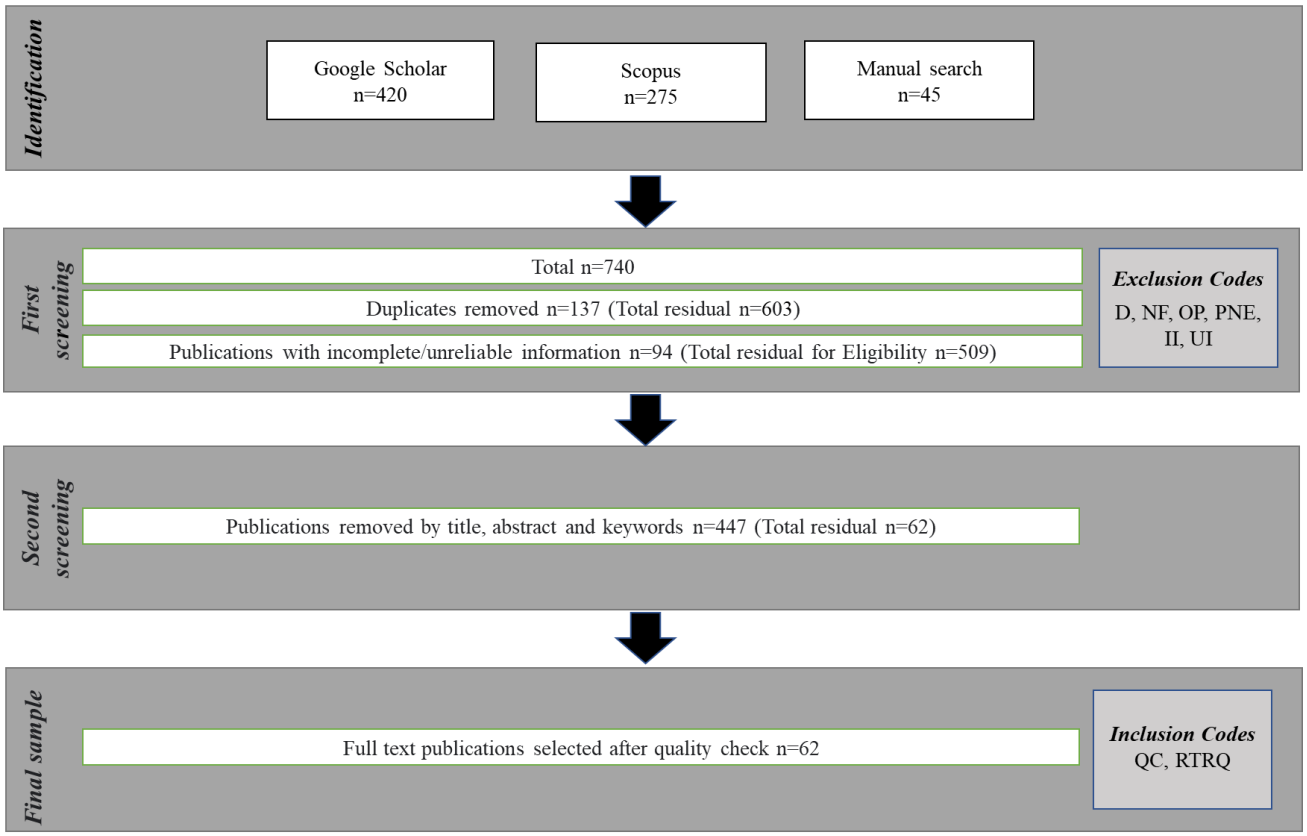
From the 558 studies collected by typing the keywords, 54 documents were selected for the review and from the 45 studies collected 8 were selected; the final dataset was thus composed of 62 articles published between 1986 and 2022. The different criteria used for exclusion/inclusion are presented below (Table 1.2 and Figure 1.5). The final sample thus has 62 items.

Table 1.2- Selection criteria

Inclusion Exclusion	***Criteria***	***Criteria Code***	***Description***	***Specific Criteria Code***	***Identified Publications***
Exclusion	***Duplication***	D	Duplicated articles in Google Scholar Duplicated articles in Scopus	DGS DS	50 3
			Duplicated articles between Google Scholar and Scopus	DGSS	84
	Not Found	NF	Untracked Publications	UP	72
	Other Publications	OP	Presentations, Reports and Reserved Works	PRRW	7
	Publications Not in English	PNE	Publications Not in English	PNE	11
	Incomplete Information	II	Year not found	YNF	2
	Unreliable Information	UI	Authors declared in the link that appears as a result of the searches not coinciding with those reported in the studies	UI	2
Inclusion	***Quality Check Relevant To the Research Questions***	QC RTRQ	Full text of the articles provides a Clear Methodology	CM	
Total identified publications (Google Scholar, Scopus and manual search) 740					
Total excluded publications 678					
Total included publications 62					

Source: personal elaboration.

Figure 1.5- Search results following PRISMA flow chart



Source: personal elaboration.

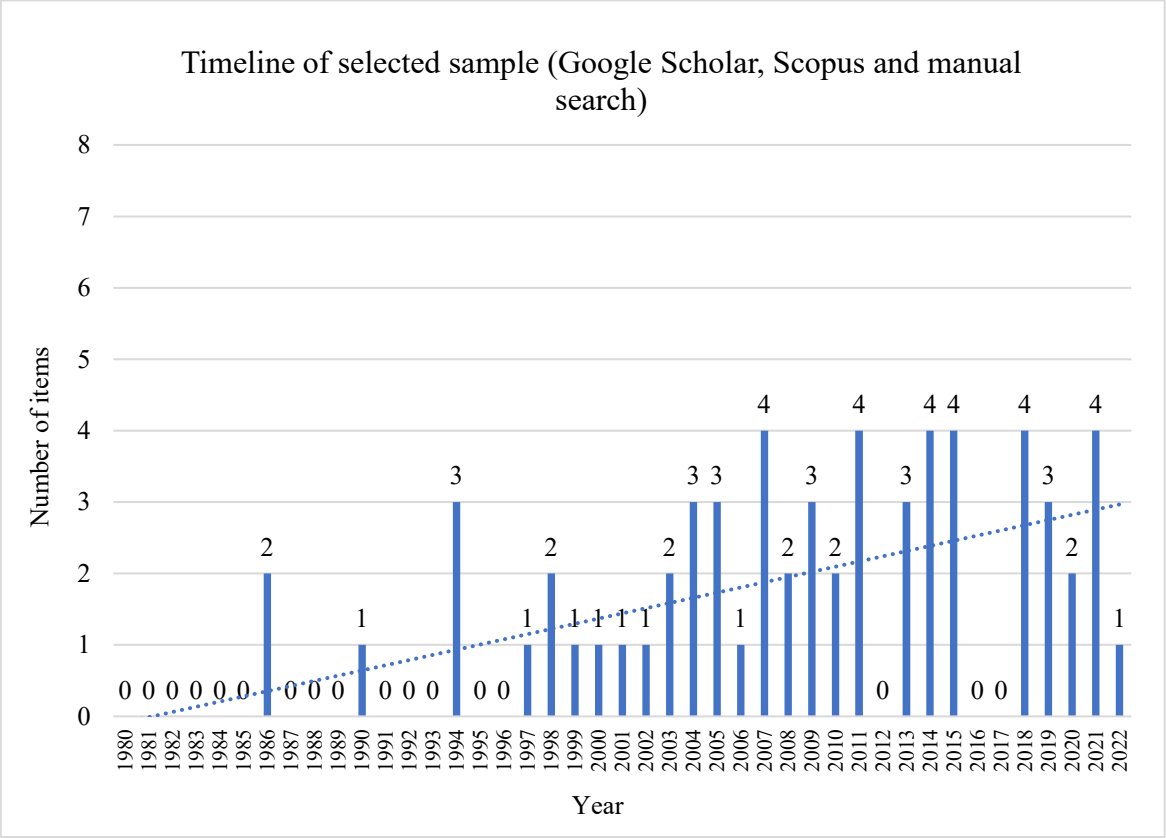
5. Systematisation of the sample

The classification of the 62 articles by type of publication (journal, site, conference) and by year of publication is provided below (highlighting the timeline of publications of the sample selected with Google Scholar, Scopus and manual search):

- published in an unedited ANVUR scientific journal: 48;
- published in a non-ANVUR accredited scientific journal: 10;
- published exclusively online (databases and online libraries, company reports, university working papers, theses): 2;
- presented at a conference/workshop: 4;
- published as a book or chapter of a book or e-book: 4.

As regards the timeline of publication of the results, the timeline of publications of 68 final sample publications analysed is set out below (Figure 1.6); each column indicates the number of articles collected per year.

Figure 1.6 - Timeline of the selected sample (Google Scholar, Scopus and manual search)



Source: personal elaboration.

6. Unit of analysis and survey perspectives in patent evaluation and methodologies for assessing patent value

After having indicated the criteria and the ways in which 62 papers, that have dealt with the issue of patent evaluation since 1980, were selected, the selected contributions were further analysed, focusing attention on the approaches adopted for measuring the value of patents.

There is indeed a wide variety of subjects that deal with the management of Research and Development (R&D) outputs through their evaluation; in particular, the evaluation of patents responds to different purposes.

While, on the one hand, economists and policy makers are interested in innovations, patents and their (aggregate) value since they are considered critical success factors, fundamental for the competitive advantages of entire nations, on the other, accountants and business strategists are interested in the evaluation of (individual) patents, for example, for correct registration in financial statements, for the purchase and sale of such assets and for a more informed management of the patent portfolio.

These authors organised the fragmented literature in a systematic manner first of all to distinguish the studies dealing with the patent value topic on the basis of the unit of analysis criterion:

- aggregate; when the data used are aggregated, large datasets or panels of data are applied to the developed models, generally econometric ones, to calculate means and medians of the distribution of values or to test the validity of the starting hypotheses (correlation of certain variables with the value of patents); these data are, for example, renewals and citations, relating to patents of a specific territory, sometimes even entire nations, or an entire sector or different sectors at the same time and limited to a given time frame;
- individual; when the data used is individual, models are developed and data used are mostly disaggregated, for example, renewals and citations but also specific data, relating to the characteristics of individual patents, held by an individual or a company or sometimes by a few competing companies.

From preliminary research carried out on the Google Scholar search engine and on the Scopus database, which collects numerous scientific publications, it appeared that there were few academic-scientific works that adopted business case studies taking a microeconomic perspective, compared to studies conducted from a macroeconomic perspective, that were aimed at developing new econometric models or refining existing models. Most probably this occurs because the information that can be obtained in public databases is more easily available than sensitive and confidential data that could be collected with field investigations.

This is confirmed by the fact that, of the 62 selected studies, 40 develop models (or refine the ones that already exist) and use datasets or data panels, including very large ones, concerning, for example, the citations or the number of countries, relative to patents of a specific territory, sometimes even entire nations, of an entire sector or of different sectors at the same time and limited to a given time frame. 22 studies develop (or simply implement) conceptual frameworks that use mostly disaggregated data, for example, the citations or the number of countries, but specific data relative to the characteristics of individual patents owned by a company.

The search for realistic estimates of the value of patents takes place, therefore, through different methods of analysis and evaluation models.

A distinction of the selected studies is proposed in the main study lines (Table 1.3 and Table 1.4), grouped according to the "unit of analysis" criterion, aggregate or individual, to which the two "survey perspectives" correspond respectively, macroeconomic/sectoral or microeconomic/corporate. According to the latter it is stated whether the methods are recognised by the International Valuation Standards (IVS, 2013, updated in 2016) and by the European Commission Expert Group Report (ECEGR, 2013).

Table 1.3- Aggregate unit of analysis

Unit of analysis	***Survey perspective***	***Strand of study***	***Selected publications***
Aggregate	Macroeconomic/ Sectoral	Econometric models are generally deterministic and stochastic based on data relating to patent families or patent renewals. These models consider the value deriving from patent protection as the difference between revenues and costs discounted over time and the value of real options.	Pakes, 1986; Schankerman and Pakes, 1986; Sullivan, 1994; Lanjouw, 1998; Wu and Tseng, 2006; Leone and Oriani, 2007; Grönqvist, 2009; Hiller *et al.*, 2018.
		Models that correlate certain variables/characteristics of the patent with its value, which is expressed through an economic indicator or other value indicators. Different variables are investigated and new indicators validated and this is generally done through a regression function.	Trajtenberg, 1990; Lerner, 1994; Harhoff *et al.*, 1999; Guellec and van Pottelsberghe de la Potterie, 2000; Lanjouw and Schankerman, 2001; Harhoff *et al.*, 2003; Reitzig, 2004; Hall *et al.*, 2005; Sapsalis and van Pottelsberghe de la Potterie, 2007; Gambardella *et al.*, 2008; Lee, 2009; Martinez-Ruiz and Aluja-Banet, 2009; Suzuki, 2011; van Zeebroeck, 2011; van Zeebroeck and van Pottelsberghe de la Potterie, 2011; Caviggioli *et al.*, 2013; Squicciarini *et al.*, 2013; Fischer and Leidinger, 2014; Thoma, 2014; Odasso *et al.*, 2015; Wang and Hsieh, 2015; Wu *et al.*, 2015; de Rassenfosse, and Jaffe, 2018; Trappey and Trappey, 2019; Cativelli *et al.*, 2021; Eom *et al.*, 2021; Svensson, 2021; Song *et al.*, 2022.
		Hybrid models, which combine characteristics of the two previous research lines.	Lanjouw *et al.*, 1998; Serrano, 2005; Bessen, 2008; Danish *et al.*, 2020.

Source: personal elaboration.

Table 1.4 - Individual unit of analysis

Unit of analysis	***Survey perspective***	***Strand of study***	***Practical specifications of the methods***	***IVS***	***ECEGR***	***Selected publications***
Individual	Microeconomic/ Corporate	Cost-based methods		X	X	Parr and Smith, 1994; Pitkethly, 1997; Razgaitis, 2002; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
		Market-based methods		X	X	
		Income-based methods		X	X	
		Option pricing-based methods				
		Indicator-based methods Scoring/Rating/Ranking			X	
		Cost-based methods	Replacement cost method	X	X	Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
			Reproduction cost method/Historical cost method	X	X	Pitkethly, 1997; Razgaitis, 2002; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
		Market-based methods	Direct market value method (Relief from royalty method categorised or in market or in income methods)	X	X	Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
			Analogy method (Transaction price of similar assets)	X	X	Pitkethly, 1997; Razgaitis, 2002; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014.
		Income-based methods	Excess profits method	X	X	Razgaitis, 2002; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.

			Incremental cash flow method	X	X	Pitkethly, 1997; Reilly and Schweihs, 2014; Parr, 2018.
			Direct cash flow method	X		
			Distributor method (disaggregated method)	X		
		Option pricing-based methods	Real Options			Pitkethly, 1997; Razgaitis, 2002; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
			Monte Carlo			Razgaitis, 2002; Lagrost *et al.*, 2010; Reilly and Schweihs, 2014; Parr, 2018.
			Decision Tree Analysis			Pitkethly, 1997; Lagrost *et al.*, 2010; Parr, 2018.
		Indicator-based methods Scoring/Rating/Ranking	Guidelines/ Description of the method		X	Raitzgaitis, 2002.
			Specific Tools/Platforms			Nielsen, 2004; Tekić *et al.*, 2014.
			Synthesis of indicators into a (few) Single (s) Index(es)			Ernst and Omland, 2011, Grimaldi *et al.*, 2018; Grimaldi and Cricelli, 2020; Song *et al.*, 2019.
		Methods developed ad hoc for specific applications (in next column, the method on which the study is built is highlighted)	Income-based methods			van Triest and Vis, 2007.
			Indicator-based methods Scoring/Rating/Ranking (MCDM, AHP, TOPSIS)			Reitzig, 2003; Malewicki and Sivakumar, 2004; Chiu and Chen, 2007; Chuang and Tanaka, 2010; Hsieh, 2013; Grimaldi *et al.*, 2015; Makundan *et al.*, 2019; Cricelli *et al.*, 2021.

Source: personal elaboration.

From a ***"macroeconomic" investigation perspective***, it is possible to report a classification of studies that deals with the aggregate values of patents.

A preliminary and informal analysis of the traced works revealed that there was a difficulty in calculating the value of the patent rights. This lies in the fact that the distribution of these values is highly asymmetric: the "skewness property", that is the asymmetry property, has been discussed by several authors (see among others, Pakes and Schankerman, 1984; Pakes, 1986; Griliches, 1990; Silverberg and Verspagen, 2004).

The first (econometric) models for the economic evaluation of patents, therefore, were developed in the 1980s and are generally divided into two study areas: models based on data relating to the renewal or families of patents and models that show a correlation between some explanatory variables and the value of the patent itself. The following are the main works divided into strands of literature (for details of all the selected studies herein, please refer to Table 1.3).

The former introduced the concepts of "discounted value of net revenues", matured by the patent and "discounted value of option". These concepts highlight how a patent guarantees not only the collection of future profits (linked to the temporary monopoly situation that patents ensure) but also the possibility of keeping the patent alive (option) for the following year (Pakes and Schankerman, 1984; Schankerman and Pakes, 1986; Pakes, 1986; Sullivan, 1994; Lanjouw, 1998; Lanjouw *et al.*, 1998).

The studies belonging to the second line try to highlight the characteristics of the patent that define its "goodness" and increase its value "deemed" to be correlated with the value, and estimate a regression function that can be used to approximate the patent value and test hypotheses on its determinants. Several authors have identified a correlation between the value of the patent and a variety of characteristics such as:

- scope of the patent (Lerner, 1994);
- citations received from subsequent patents or forward citations (Trajtenberg, 1990; Harhoff *et al.*, 1999; Harhoff *et al.*, 2003b; Gambardella *et al.*, 2008);
- citations to previous patents or backward citations (Lanjouw and Schankerman, 1999; Harhoff *et al.*, 2003b; Gambardella *et al.*, 2008);
- references to non-patent literature (Harhoff *et al.*, 2003b);

- family size, understood as the number of jurisdictions or countries in which the patent is granted (Lanjouw *et al.*, 1998; Harhoff *et al.*, 2003b; Lanjouw, 1998; Squicciarini *et al.*, 2013; Gambardella *et al.*, 2008);
- age of the patent, which is a number between 3 and 20, since the renewal decision is made every year between the third and twentieth years;
- number of complaints or claims (Lanjouw, 1998, Gambardella *et al.*, 2008);
- renewal rates (De Rassenfosse and Jaffe, 2018).

It is also possible to trace some hybrid studies that combine characteristics belonging to the two previous lines of study (Lanjouw *et al.*, 1998; Serrano, 2005; Bessen, 2008; Danish *et al.*, 2020).

By shifting attention to a ***"microeconomic" investigation perspective***, it emerges that the evaluation of individual patents, typically in a business context, takes place from a strategic R&D management perspective, depending on the purpose of the evaluation (Flignor and Orozco, 2006; Lagrost *et al.*, 2010), which are mainly:

- for recognition in the financial statements of companies that exceed certain size limits;
- for the purchase and sale of the patent right on the market;
- for a more conscious management of these assets, in relation to, intrinsic properties of the patent (mainly, those related to legal status and technology in the strict sense) and its extrinsic properties (mainly, those related to the market, economic and strategic sphere).

In carrying out an assessment of individual intellectual assets, the assessors/experts on the subject can choose between different approaches which, in relation to the above-mentioned objectives, the required inputs and the expected final output, can be divided into quantitative and qualitative (Kamiyama *et al.*, 2006).

Quantitative methods answer the question "how much"; they can be defined as systematic and reproducible methods, which provide an objective approach to evaluation (Lagrost *et al.*, 2010), making use of measurable numbers and data such as costs and revenues. The result deriving from the valuation consists of a value expressed in monetary terms.

Specifically, the prevailing literature identifies and describes three "classic", typically quantitative, approaches, which can be used in the evaluation of tangible corporate assets and are also extendable to intangible ones (Parr and Smith, 1994; Pitkethly, 1997; Reilly and Schweihs, 1998; 2014; Razgaitis, 2002; 2009; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Parr, 2018):

- cost-based methods;
- market-based methods;
- income-based methods.

The three approaches are also stated in the IVS of 2013, updated in 2016 (standard no. 105, "Valuation Approaches", extending them to intangible assets, IVS no. 210, "Intangible assets") and in the ECEGR of 2013 (for details of all the selected studies herein, please refer to Table 1.4).

It is also possible to identify more advanced methods that are not recognised by international standards and reports, namely the option pricing-based methods (applicable through the real options), Montecarlo or decision tree methods.

Qualitative methods answer the question "why and how"; they can be defined as methods that are based on an interpretative and subjective approach to evaluation (Lagrost *et al.*, 2010), using words, characteristics and bibliometric data relating to the asset; the latter represent indicators of value or proxies.

Qualitative methods are certainly based on the perceptions of respondents to questionnaires and allow the implementation of case studies and are recognised by ECEGR but not by IVS. They are expressed through Key Performance Indicators (KPIs) and are generally assessed using a questionnaire.

Qualitative methods are often implemented through clear and reproducible approaches, such as the rating and scoring of different factors, in this case not to answer the question "how much" but "why and how?". However, the output deriving from the evaluation is represented by a single score for each indicator considered, which contributes to a final score.

They do not provide a monetary value, and are instead methods used for managerial and strategic considerations, although a higher score in certain indicators indicates that the asset has a better chance of generating economic returns.

Specifically, the conceptual frameworks that are easily applicable at a company level provide, for example, especially in the case of indicators for measuring the value of the patent, a range of indices by grouping them into main categories, drawing up a ranking and/or developing a guideline to be followed step by step.

Specific institutional platforms have been thus developed like the Intellectual Property Score (IP Score; Nielsen, 2004) and Patent Search and Analysis for Landscaping and Management (PSALM; Tekić *et al.*, 2014), which are based on the (bibliometric) indicators validated with aggregated data (Reitzig, 2004 and Van Zeebroeck, 2011) and guidelines of the rating/ranking method (Razgaitis,

2002), but also academic-scientific studies developed ad hoc that allow the synthesis/calculation of single indices (Ernst and Omland, 2011, Grimaldi *et al.*, 2018; Grimaldi and Cricelli, 2020; Song *et al.*, 2019).

Moreover, mathematical approaches have been developed to evaluate the patent portfolio and measure the importance of alternatives based on Multiple Criteria Decision Making (MCDM), Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solutions (TOPSIS).

In general, the methods that refer to the cost approach and the market approach are quite simple to apply. If the data relating to costs and prices are reliable and available but provide information that must be integrated with economic-income information such as that relating to future cash flow and supplemented by considerations inherent to the quality and strength of patents to have hybrid and most complete valuations.

Ultimately, hybrid valuations, which combine both "pure" quantitative methods and qualitative (or better qualitative-quantitative) methods, seem to be the most complete: the monetary value is supplemented by considerations concerning the quality and strength of patents and at the same time the latter are less affected by the subjectivity of the valuation.

In Chapter 2, a description of each approach is provided, highlighting, in particular, the micro-perspective indicators approach that focuses on the strategic management of patents.

Discussion and Conclusions

The objective of this chapter was to answer Research Question 1 (RQ1), reported in the Introduction to the doctoral thesis and referred to below:

- ✓ *RQ1- How is managerial economic literature evolving on the topic of patent value?*

This work aimed to provide an overview of the topic of "patent value", on the attention paid to it by the scientific community, while focusing in particular on the methodologies used to calculate it.

This mainly concerns both the consideration of some aspects, typically the economic-income ones, such as the expected flows deriving from the exploitation of the patent over time, and the search for value determinants, that is, indicators for measuring the value of the patent.

It is possible to observe how the literature on the subject is highly fragmented, in terms of objectives deriving from the evaluation and corresponding audiences and methodologies used. Thus, there is a

need for a systematic organisation of studies. Indeed, while it is possible to trace numerous studies on the subject of patent value, there is a need for their systematic organisation in order to allow different subjects (scholars, policymakers and business practitioners) to have an overview of the state of the art of the topic and move between different methodologies depending on the different objectives to be achieved with the evaluation.

For this reason, a review of the literature is set out on the basis of trends in the study of topics, survey perspective and conceptual frameworks, with particular attention to those applicable at the corporate level.

The analysis conducted highlights the fact that the issue of measuring the value of patents has received increasing attention from the scientific community; more than half of the traced publications were included in a scientific journal and 2/3 of these in an ANVUR-accredited scientific journal.

In particular, this analysis wants to consider both the two perspectives of investigation, macro and micro, because as noted by Pitkethly (2006), most publications that provide econometric methods of patent valuation generally deal with aggregate values rather than single patent values. This occurs because the information that can be obtained in public databases is more easily available than sensitive and confidential data that could be collected with field investigations.

From a "macroeconomic" investigation perspective, it is possible to highlight two main lines of literature: the first collects studies that use information relating to renewal behaviours by patent holders to solve the problem of the asymmetry of value distributions of the patent (see, in particular, the pioneering works of Pakes and Schankerman 1984, Pakes, 1986, Schankerman and Pakes, 1986 and the work of Lanjouw, 1998 which represents an improvement). The second collects the studies that use a set of variables "deemed" to be correlated to the value and estimate a regression function that can be used to approximate the patent value and verify hypotheses on its determinants (see, among others, the works of Lerner, 1994). There are also studies that use a hybrid approach, that is, that combine the characteristics of the previous two (Lanjouw *et al.*, 1998; Serrano, 2005; Bessen, 2008; Danish *et al.*, 2020).

From a "microeconomic" investigation perspective, it emerges that the individual patents are evaluated, typically in a business context, depending on the purpose of the evaluation, using through two main methods: the first are the quantitative methods that provide a monetary economic value, expressed in dollars or euros of the patent using quantitative variables (Parr and Smith, 1994; Reilly and Schweihs, 1998; 2014; Pitkethly, 1997; Razgaitis, 2002; 2009; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Parr, 2018) The second are the qualitative methods that provide a score value, on the basis of

a set of characteristics that best represent the quality, effectiveness and industrial feasibility (Razgaitis, 2002, Grimaldi *et al.*, 2018; Grimaldi and Cricelli, 2020; Song *et al.*, 2019) of an intellectual property right. They are expressed through Key Performance Indicators (KPIs) and are generally evaluated through a questionnaire.

Depending on the purpose and context of the assessment, the patent takes different values; therefore, there is no one method that is better than the others in absolute terms. It depends on the purposes of who evaluates and can vary, for example, if the evaluator is a subject who wants to sell the patent, or wants to use the patent as a basis for obtaining financing for a start-up, or the evaluator is a potential buyer of the patent or a lender of a start-up that has a patent among the assets to be valued.

On focusing on the evaluation of individual patents, it emerges that accountants and business strategists (but not only), are interested in the evaluation of patents, for example, for correct registration in financial statements, for the purchase and sale of such assets and for a more informed management of the patent portfolio.

The assessors on the subject can be the accountants themselves, business strategists or other subjects interested in the valuation, or consultants, who can be experts either in the technical element of the innovation or in the economic part that the patent protects, sometimes employed in patent offices.

Despite the study's limitation of the research, it has provided an in-depth picture of the main patent valuation methods. In particular, the chapter has highlighted how most of the scholars who have addressed the topic have adopted a macro analysis perspective dominated by an econometric approach, trying to understand the role of patents in the general economy of a country or of entire manufacturing sectors.

Therefore, the evaluation of patents by individual companies associated with individual valuation methods for strategic R&D management has instead received less attention in literature, although the value of patents depends very much on the methodologies adopted, in turn linked to the purposes and to the subjects involved in the valuation. From a managerial point of view, the research provides a map of the main evaluation methods that can be adopted by managers to understand the opportunity to acquire, sell or renew a patent, providing useful guidelines for evaluation processes.

Moreover, from the point of view of the practical and managerial implications, it emerges that since the end of the last century, an attempt has been made to apply more advanced methods, born in the

area of corporate finance, such as those that fall within real options and further ones such as Monte Carlo and decision trees, which represent an evolution of income-based methods.

The distinction between quantitative and qualitative methods so immediate and clear on a theoretical level (what is not quantitative/objectively measurable is necessarily qualitative/subjective) does not appear to be so on a practical level.

Hybrid valuations, which combine both quantitative and qualitative methods, appear to be the most complete: the monetary value is supplemented by considerations inherent to the quality and strength of patents and at the same time the latter are less affected by the subjectivity of the valuation. Access to sensitive and confidential data, however, that could be collected with on-site investigations in the company always remains problematic.

In the future it would be interesting to deepen these issues also in light of the explosion of the phenomenon of innovative start-ups, where the evaluation of patents affects a large part of the evaluation of nascent companies.

For these reasons, there is a need for an in-depth analysis of the microeconomic perspective (proposed in Chapter 2), that consider not only the evaluation of individual patents but, comprehensively, their strategic management in the companies.

A description of the single approaches applied to patent evaluation is also given according to several objectives/purposes, in particular highlighting the characteristics of the indicators approach that is related with the development of institutional platforms, that are focused not only on the technological and legal aspects of patents but also broadly on their economic, market and strategic characteristics.

CHAPTER 2

Strategic patent management in corporate contexts:

a summary of the literature

Introduction

The objective of this chapter is to answer Research Question 2 (RQ2), reported in the Introduction to the doctoral thesis and referred to below:

- ✓ *RQ2- What are the main characteristics of the conceptual models used for patent evaluation in corporate contexts?*

Appropriation of the value deriving from innovative processes varies depending on the sector and the specific context and can take place in various ways. These range from the creation of strategies capable of making the most of innovations, continuously innovating better than competitors, from the execution of licensing and collaboration agreements aimed at exploiting complementary skills of partners to strengthen competitive positioning up to legal protection through patents.

In this regard, during the Twenties, as demonstrated by World Intellectual Property Organization (WIPO) statistics, patent applications by companies have significantly increased at an international level and this has also occurred in recent years since 2020.

The choice between patenting and secrecy represents, however, only the first step of a much broader and multi-dimensional strategy.

In light of the lack of attention dedicated by academic literature to the strategic aspects inherent to patents, a framework of the strategic decisions that a company should follow to appropriate the value generated by technological innovations is provided.

It is a conceptual layout capable of illustrating the different options that companies can adopt to appropriate the value of innovations, within which patents require particular attention, from the definition of precise and challenging objectives that they want to achieve with each of them, up to their strategic management, which can be supported by the application of patent evaluation approaches/methods.

To answer the research question, the literature on the subject of strategies and management of individual patents has been analysed and a summary will be presented that illustrates the choices that companies could make on the topic in question.

In order to delve into the specific topic of strategic patent management, it is useful to include some key concepts from literature on competitive strategy and innovation management in the conceptual premise to the chapter. Subsequently, the proposed process on patent management concludes with the literature on patent evaluation.

In particular, the chapter allows us to pursue the following objectives:

(i) placing corporate patenting in the broader context of corporate strategy and innovation policy, as patenting choices are made downstream of the corporate innovation process, and the latter is part of corporate strategic choices made in order to compete;

(ii) understanding the advantages and disadvantages deriving from patenting and secrecy, the different patenting strategies (offensive, defensive or leveraging) and the main models for the qualitative-quantitative evaluation of individual patents.

This chapter is structured as follows:

(i) the first paragraph reports the basic concepts of strategy and innovation as a premise to the topic of strategic patenting;

(ii) the second paragraph presents a summary that and highlights the main alternatives available to companies, if they want to manage innovations in a strategic manner;

(iii) the third paragraph provides an overview of the main strategic alternatives, patenting, secrecy or strategic disclosure, that, in the first instance, a company has at its disposal to appropriate the value deriving from technological innovations, generally underlining the pros and cons;

(iv) the fourth paragraph delves into the concept of “patent strategy”, on the basis of the so-called “strategic intentions deriving from patenting”, distinguishing between

internal exploitation strategies and external exploitation strategies: offensive, defensive and leveraging;

(v) the fifth paragraph delves into the main characteristics of the quantitative and qualitative methods applicable for the evaluation of individual patents in corporate contexts;

(vi) the sixth paragraph focuses on a software tool developed for the evaluation of patents, technologies and research projects, which is performed by considering factors relating to five dimensions of value: legal status, technology, market, finance and strategy.

Finally, a discussion of the results is included, including the usefulness that a specific simplified model can have for the evaluation of patents in corporate contexts is highlighted.

1. Competitive strategies and corporate innovation: some key concepts

To contextualise and understand the choices inherent to the strategic management of patents, it is useful to recall some key concepts from literature on business strategy and innovation.

Strategy can be defined as "the way in which the company uses its resources and skills within the business sector to achieve its objectives" (Grant, 2005, page 53) and for a strategy to be successful it is necessary that there is coherence between the characteristics of the external environment and those of the internal environment: objectives and values, resources and skills, structures and systems (Grant, 2005).

Business strategy at the corporate level, i.e. in terms of products and services offered and breadth of geographical scope, provides four options (Ansoff, 1987): market penetration, product development, market development and conglomerate diversification.

To achieve competitive advantages and performance above the business or sector average, companies can basically choose the following competitive strategies (Porter, 1987), which are not mutually exclusive: *cost leadership* (for the same product, the company has a significant cost advantage over its competitors) and *differentiation leadership* (the company offers products or services that have unique characteristics and are perceived as superior to those of rivals; for this reason the company can obtain a premium price).

Generally, the competitive advantage of differentiation is preferable to the competitive advantage of low cost for its sustainability because it is less vulnerable to changes in the external environment and is more difficult to imitate (Grant, 2005). However, both competitive advantages can be imitated due to ever-increasing competition and the growing reduction in the product life cycle (Pellicelli, 2005), and especially where there are no barriers to imitation, it is necessary to develop competitive strategies based on efficiency, quality, innovation and responsiveness to customers (Hill, Jones, 1998; Cooper, 1995).

To obtain competitive differentiation advantages, companies must be able to excel in the Key Success Factors (KSFs) of the sector. In general, the main KSFs are: information and communication, product, product cost, product delivery and production (Sousa De Vasconcellos E Sà and Hambrick, 1989). More recently, especially in technologically advanced sectors, further KSFs are brand (Temperini *et al.*, 2016; Kotler *et al.* 2021) design and innovation (Verganti, 2008; Conti *et al.*, 2019).

An increasingly relevant dimension that helps to explain the company's strategic performance has become the dimension that concerns internal processes of innovation and learning (Conti and Pencarelli, 2011). It is about important variables to monitor since the complexity of competitive contexts leads to continuous changes in the distinctive skills possessed by companies, forcing them to invest in continuous innovation in processes, products, markets, skills possessed and managerial methods (Hamel, 2008).

The innovative capacity of enterprises is linked to their ability to listen and to perceive unexpressed needs, or rather to the marketing orientation of the businesses. Particularly in the digital era, it is increasingly important to be adept at listening to online conversations and interpreting the vast amount of data available (Gregori and Pascucci, 2019).

Indeed, innovation creates value for the companies and society as a whole and favours the unification of markets worldwide, especially over the last few decades during which the rapid development and diffusion of technological innovations has accelerated the phenomenon of globalisation.

It is possible to identify different types of innovation (Schumpeter, 1950), although in corporate contexts there are mainly two: product and process, and based on intensity, whether radical or incremental (Ferrucci, 2020).

Indeed, the innovation policy traditionally falls within the broader product policy, which is part of the so-called 4Ps of marketing: Product, Price, Promotion and Place. Marketing professionals are responsible for making strategic decisions regarding these elements (Ferrero, 2018).

There are also different possible sources of innovation (Comacchio, 1996; Bettiol and Micelli, 2014): learning by doing, learning by searching and learning by using.

Innovation can be technology push or demand pull. Regarding New Product Development (NPD), linear step-by-step models (from idea to market launch) are now outdated and interactive models prevail (Cillo and Verona, 2009). Today, fourth and fifth generation product innovation models prevail (in parallel, system and networking integration) which take a systemic view (open innovation) of the innovation process and consider the network of external actors who possess complementary resources and skills to be strategic (Chesbrough, 2003).

The ability to generate new knowledge (through internal investments in research) and moreover to absorb it (integrating external knowledge) and appropriation of the value thus generated (through formal protection of intellectual property) are determinants of growth in the different innovation patterns (Piccaluga *et al.*, 2019).

In the actual constantly changing context, businesses need a continuous generation of technological innovations (developed by the companies themselves or by Universities or research centres) to achieve lasting competitive advantages, especially in technologically advanced sectors and, at the same time, the definition of a clear strategy that allows the appropriation of the value deriving from them.

Innovative performance measures the degree of modernisation and competitiveness achieved by the company compared to the competition and one important measurement tool is the patent.

Therefore, given that to compete today, companies must base their competitive strategies on differentiation and continuous innovation, it becomes important to also manage the choices downstream of the innovative processes and therefore relating to strategic patenting.

2. The sequence of patenting decisions

Following the introduction of new products on the market or new business processes, companies are faced with numerous choices: is patenting or secrecy preferable? If patenting is preferred, what strategy can be practiced? How are patents managed?

This paragraph presents a conceptual summary, developed from the critical analysis of literature on the topics of interest, which highlights the alternatives available to companies if they want to manage innovations strategically (Figure 2.1 and Table 2.1).

In fact, the choice between patenting and secrecy represents only the first step of a much broader and multi-dimensional strategy. The sequence of strategic decisions that companies find themselves having to make can, therefore, be summarised step by step as follows.

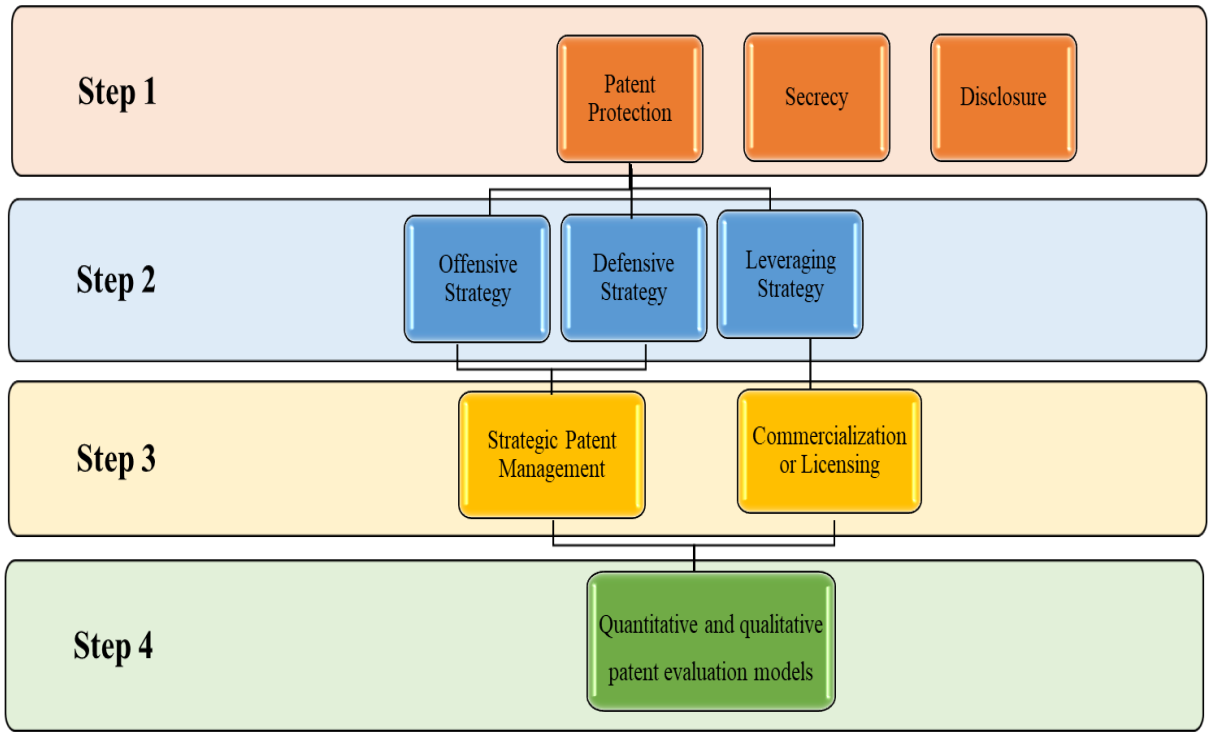
- Step 1: choice of the methodology for appropriating the value deriving from technological innovations; the strategic choice essentially falls between these two alternatives: patenting or secrecy. In technologically advanced sectors, strategic disclosure is sometimes also preferred, in order to push forward the current state of research.

- Step 2: definition of the patent strategy; nowadays the protection of technological innovations through patenting is increasing, so much so that numerous companies are inclined, generally speaking, to favour patenting as a tool for protecting products and/or processes.
  However, it is necessary, specifically, to define the strategic intentions deriving from patenting for each individual patent, i.e. the objectives that one wants to achieve with each of them: acquisition or maintenance of a competitive advantage (offensive strategy), freedom in continuing to market one's own technologies (defensive strategy) or obtaining additional income mostly through marketing or licensing (leveraging strategy).

- Step 3: management of patents as assets and specific support tools to evaluate them; patents should not only be considered in relation to the technological aspects of the innovations they protect (mainly handled by internal departments of the firm) and the legal aspects (generally handled by external law and consultancy firms), but also to the economic, market and, in a broad sense, strategic ones.

- Step 4: the chapter focuses attention on a software tool which defines the "patent value" as the concomitant result of five different dimensions of value, which various scholars in literature interpret and apply to cases business studies.

Figure 2.1- A synthesis of the literature: main strategies and decisions to appropriate the value deriving from innovations



Source: personal elaboration.

Table 2.1- Main quantitative and qualitative approaches to the evaluation of patents

Patent evaluation methods	
Quantitative methods *(Monetary value)*	**Qualitative methods** *(Score)*
Cost Approach Market Approach Income Approach Real Option Approach	Patent Indicators Approach

Source: personal elaboration.

Below, the various steps for the appropriation of the value deriving from the innovations, briefly exposed above, are described.

3. Appropriation of the value deriving from technological innovations

Appropriation of the value deriving from innovative processes becomes fundamental, especially in the current globalised and hyper-competitive contexts.

This appropriation varies depending on the sector and the specific context and can take place in various ways. These range from the creation of strategies capable of making the most of innovations, continuously innovating better than competitors, the execution of licensing and collaboration agreements aimed at exploiting complementary skills of partners to strengthen competitive positioning up to legal protection through patents.

Companies that want to appropriate the value of technological innovations find themselves, in the first instance, faced with the choice between two alternatives, patent protection or secrecy, although, in technologically advanced sectors, strategic disclosure is sometimes also preferred, in order to "push forward" the current state of research.

As regards patent protection, as indicated by the Industrial Property Code (Italian Legislative Decree no, 30 of 10 February 2005), the patent is a legal title that recognises an intellectual property right, guaranteed by a sovereign state (and therefore territorially delimited by geographical borders) to an inventor for a limited period of 20 years, a term which cannot be renewed or extended. This "standard" duration is shared by various countries of the world or at least, to our knowledge, in the main areas.

In particular, in fact, this term applies to Italy but also to the case of obtaining a patent in the United States of America (USA) and the case of patents that refer to extended geographical areas such as the European patent (which, once obtained, is "nationalised" in the individual countries in which one wishes to benefit from the protection) and the Eurasian one (for which, the countries in which the protection is valid are fixed, without the possibility of choice by the owner).

In order to obtain a patent, the invention must be new on a global scale, non-obvious and unique compared to the prior art (i.e. the state of the art up to that point), susceptible to industrial application (i.e. be configured as an innovation technology that can be incorporated into products/services that can be sold on the market) and obviously lawful (i.e. not contrary to public order and morality).

Patent protection guarantees an exclusive right to the owner to use the invention in a specific place and for a specific period. In this way, without the owner's authorisation it is not possible to use, disseminate or assume ownership rights; therefore, this exclusive right guarantees the commercial exploitation of the innovation.

This creates a position of semi-monopolistic competitive advantage which represents, according to some authors, the most powerful advantage deriving from patenting (Rivette and Kline, 2000).

Furthermore, patents contribute to building relationships with partners and investors, who rarely build them on the basis of knowledge kept secret and this contributes to a positive corporate image in the eyes of final customers.

On the basis of an authoritative study that is still very current and widely cited by patent studies (Cohen *et al.*, 2000), based on a survey of 1478 research and development laboratories in the US manufacturing sector in 1994, it is possible to trace further reasons that lead companies to the decision to patent. In particular, the reasons are the following: prevention against the imitation of competitors, prevention against rivals from patenting related inventions (i.e. blocking the patent), the use of patents in negotiations and the prevention of legal actions.

At the same time, patent protection has disadvantages. In fact, in exchange and in advance, it requires a public and detailed disclosure of the characteristics of the invention.

Although non-imitation is one of the major benefits recognised by patents, it cannot be overlooked that, from a technological point of view, imitation by competitors is only partially discouraged, as they benefit from such detailed information, which they can use to develop further innovations.

Furthermore, it may be necessary to build overlapping and complementary property rights, to prevent the set of patents from being circumvented or overturned and thus increase the protection granted by individual patents.

Finally, another important aspect is represented by the fact that patent protection in each country is expensive and the costs required discourage applications for patents, as well as the costs that, if necessary, would have to be incurred to defend yourself in court.

On the contrary, secrecy does not require disclosure of the characteristics of the innovation, there is no waiting to obtain the patent, nor any economic expense; it also guarantees an important share of profits for inventions with a short life cycle. In this case, the company will benefit from the so-called internal “know-how”.

At the same time, however, keeping information secret involves other types of costs such as, for example, a non-compete fee for selected employees.

Furthermore, no legal protection is recognised in the event of equal innovation that a competitor can lawfully achieve (Peters *et al.*, 2013) and, even if a product/process is copied, it will be difficult to win any possible lawsuit (Reitzig, 2004).

Finally, as regards strategic disclosure, it is rarely practiced (Peters *et al.*, 2013), especially in technologically advanced and internationalised sectors, and this can generally happen if the disclosing company wants to make the knowledge public to "push forward" research, leading to faster technological progress in the sector and advantages compared to the exclusive patent right (Pisano, 2006). As in the case of secrecy, there is no need to wait to obtain the patent and no financial expense is required.

As with other strategic business decisions, the choice between patent protection and secrecy and, more rarely disclosure, can occur at different corporate levels: corporate, business or functional.

In fact, the choice of patenting can dictate a company guideline in this sense for appropriation of the value of technological innovations, but can also be revised from time to time for individual products/processes.

Companies, generally speaking, are more inclined to patent products and keep processes secret (Holgersson, 2012), because the products are placed on the market and, for this reason, are more easily subject to plagiarism but they can also opt for the choice of secrecy limited to some products.

4. Corporate patent strategies

In this paragraph we focus on the possible patenting strategies that companies can adopt.

During the 2000s, as demonstrated by WIPO statistics, patent applications by companies increased sharply at an international level and this also occurred in the most recent years following 2020.

In fact, it emerged that during the decade 2008-2018, there was an increase in all Intellectual Property titles and, in particular, with regard to patents, by approximately 60%. This increase in all Intellectual Property titles was also recorded from 2020 to 2021 and, in particular, with regard to patents, by approximately 5%.

In general, intellectual property rights can be defined as the set of tools aimed at protecting, in a broad sense, the different forms of "creations of the mind" against the risk of imitation and, consequently,

legally appropriate the value deriving from such creations; this term refers not only to innovations but also to literary and artistic works, symbols and forms used for commercial purposes.

The main IP titles, recognised by the legislation of numerous countries, are patents, trademarks, copyrights and industrial secrets, which respectively protect innovations, commercial brands, literary/artistic works and industrial secrets.

Also in light of the increase at international level in recent years, this work focuses on patents (and, in particular, on their strategic management), as titles that specifically protect innovations, typically product and process, for the purpose of their commercial exploitation, although the risk of imitation by direct and indirect competitors is only partially stemmed by patents as the public and detailed disclosure of the characteristics of the innovation is required in exchange for the exclusive right of commercial exploitation.

Once the company opts for patent protection, definition of the patent strategy becomes necessary.

In line with some authors (Grimaldi *et al.*, 2014), from a strategic perspective, it is necessary to define the "strategic intentions deriving from patenting" (Arundel and Patel, 2003; Gilardoni, 2007; Kingston, 2001; Tseng *et al.*, 2011) and this should be done for each individual patent.

It is essentially a matter of clearly explaining the objectives, in terms of competitive and economic-financial advantages, that one wants to achieve with the individual patented products/processes: acquisition or maintenance of a competitive advantage, freedom in continuing to market one's technologies or obtaining additional income.

Therefore, if the objective that the company wants to achieve with the patented product/process is that of acquiring or maintaining a competitive advantage, the strategy pursued is offensive or proprietary; if the objective is to preserve freedom in continuing to market their technologies, the strategy pursued is defensive, while if the intention is to obtain additional income mostly through marketing or licensing of the patent, the strategy is called leveraging.

The proprietary/offensive patent strategy is pursued with those patents by which the company seeks to create and maintain a lasting competitive advantage; therefore, offensive strategic intentions refer to those patents that have the objective of establishing and maintaining advantageous market and competitive positions (Ernst and Omland, 2011; Zahra and Corvin, 1993). Reasonably, this occurs through the patents that cover new products in the portfolio.

These are central technologies for the company and for the sector; it is difficult for the company to license the patents with which it is pursuing this type of strategy (Somaya, 2012).

The defensive patent strategy aims to preserve the company's freedom to operate and market their technologies without impediment by patents belonging to others; reasonably, this happens through the patents that cover old products in the portfolio.

In particular, defensive strategic intentions refer to those patents that have the objective of safeguarding inventions from external competition (Blind *et al.*, 2009; Ernst, 2003), protecting inventions and blocking other companies from using them (Gilardoni, 2007; Lagrost *et al.*, 2010) and improve the company's image (Arundel and Patel, 2003; Sullivan, 1998).

The leveraging patent strategy aims to negotiate and obtain income and, therefore, refers to those patents that are marketed or licensed; in fact, the classic example in this sense is that of "patent licensing revenues", although others exist (Somaya, 2012).

In this case, literature does not speak specifically of leveraging strategic intentions (since the strategic intentions analysed are offensive and defensive ones) but the aim is certainly that of obtaining new profit opportunities.

Offensive and defensive strategies are, therefore, strategies for the internal exploitation of patents in order to achieve a position of competitive advantage or to continue to exploit one's patents without being hindered by competitors, while leveraging strategies are strategies for the external exploitation of patents that materialise in their marketing or in their licensing.

5. The main approaches used to evaluate individual patents

This paragraph illustrates the characteristics of the main quantitative and qualitative models that can be used for the evaluation of patents, starting from the idea that, when internal exploitation is preferred rather than external exploitation, patent management can benefit from the considerations deriving from their evaluation.

Depending on the objectives of the evaluation, the different methods of patent evaluation (already highlighted in Chapter 1) allow in depth costs (cost methods), revenues (income and real options

methods) and characteristics (indicator method) of patents to be analysed, encouraging dissemination on the topic within the company and, consequently, greater awareness of their management.

In literature, in fact, it is possible to identify various approaches used for the evaluation of patents in corporate contexts; after referring to the literature review previously conducted, the main characteristics of the quantitative and qualitative methods of evaluating individual patents, specifically applicable in corporate contexts, are described below.

In carrying out an assessment of individual intellectual assets, specifically patents, the assessors/experts on the subject can choose between different approaches which, in relation to the above-mentioned objectives, the required inputs (data) and the expected final output (monetary/non-monetary valuation), can be divided into quantitative and qualitative (Kamiyama *et al.*, 2006).

Quantitative methods answer the question "how much"; they can be defined as systematic and reproducible methods, which provide an objective approach to evaluation (Lagrost *et al.*, 2010), making use of measurable numbers and data such as costs and revenues. The result deriving from the valuation consists of a value expressed in monetary terms.

Specifically, the prevailing literature identifies and describes three "classic", typically quantitative, approaches, which can be used in the valuation of tangible corporate assets and are also extendable to intangible ones (Parr and Smith, 1994; Pitkethly, 1997; Reilly and Schweihs, 1998; 2014; Razgaitis, 2002; 2009; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Parr, 2018):

- cost-based methods;
- market-based methods;
- income-based methods.

It is also possible to identify more advanced methods, that are, the option pricing-based methods (applicable through the real options, Montecarlo or decision trees methods).

Qualitative methods answer the question "why and how"; they can be defined as methods that are based on an interpretative and subjective approach to evaluation (Lagrost *et al.*, 2010), using words, characteristics and bibliometric data relating to the asset; the latter represent indicators of value or proxies.

Qualitative methods are certainly based on qualitative data, such as the perceptions of respondents to questionnaires, and allow the implementation of case studies. They are expressed through KPIs and are generally assessed using a questionnaire.

Qualitative methods are often implemented through clear and reproducible approaches, such as the rating and scoring of different factors, in this case not to answer the question “how much” but “why and how?”, but the output deriving from the evaluation is represented by a single score for each indicator considered, which contributes to a final score.

Not providing a monetary value, they are methods used for managerial and strategic considerations, although a higher score in certain indicators indicates that the asset has a better chance of generating economic returns.

Specifically, the conceptual frameworks that are easily applicable at a company level provide, for example, a range of indices by grouping them into main categories, especially in the case of indicators for measuring the value of the patent, drawing up a rating scale and/or developing a guideline to be followed step by step.

The evaluation is elaborated by a set of values; appropriate indices are analysed which are linked to the value of the patent on the basis of econometric studies, and an attempt is made to classify patents within rating scales (Razgaitis 2002; 2009). The evaluations allow a single score to be reached for each patent and a comparison of the patents to be made on the basis of common parameters.

Specific institutional platforms have been thus developed to evaluate patents, such as IPScore (Nielsen, 2004) and PSALM (Tekić *et al.*, 2014). These platforms are based on the (bibliometric) indicators validated with aggregated data (Reitzig, 2004 and Van Zeebroeck, 2011) and guidelines of the rating/ranking method. Also, academic-scientific studies have developed an ad hoc measurement scale that allows the synthesis/calculation of single indices.

Moreover, mathematical approaches have been developed to evaluate the patent portfolio and measure the importance of alternatives based on the MCDM, the AHP and the TOPSIS methods.

Below, we proceed with the description of the various methods.

Cost Approach

The methods that refer to the Cost Approach allow, through an analytical quantification, the costs incurred in the past to create the patent (more correctly also those to create the innovation that the patent covers) to be identified, by updating them at the moment of the evaluation.

The basic assumption of these methods is that a buyer will pay no more for an asset than the cost of obtaining an asset of equal utility, either through purchase or through construction.

On the basis of the *revalued historical costs method*, it is necessary to identify the most significant costs incurred in the past to create the patent, which are those relating to research, development and prototyping/engineering (necessary to achieve innovation) and those relating to the patent in the strict sense (research patents, legal, application, concession, registration and maintenance fees). Some authors (Vasco, 2008) also identify the costs of developing the sales network, promotional and advertising costs.

Although the data collected are objective/reliable, the consideration of historical costs presents a limit: the change in the purchasing power of the currency and also in the economic conditions; this limit can be faced through a reassessment of the costs with appropriate indices.

Nevertheless, based only on past data, there is not much adherence to economic reality and not even a consideration of future economic benefits (although this applies to all methods attributable to the Cost Approach). A step up from this method is the reproduction cost method and the replacement cost method.

The *reproduction costs method* allows the value of the intangible asset to be calculated by adding the costs necessary at the time of valuation to reconstruct an exact copy of the intangible asset covered by a patent. The costs to be considered are always those relating to research, development, prototyping and patenting costs. IPRs assets (patents in our case) are characterised by the uniqueness and novelty of the innovation they protect and, therefore, an exact replica could not be created.

The *replacement cost method* allows the calculation of the value of the intangible asset by estimating the costs necessary to develop an asset of similar utility; in this case we do not want to reconstruct an exact copy but an improved version. For a more realistic estimate of the patent value, it would be preferable to apply the replacement cost method.

This approach provides a minimum value to compare with other approaches, the most accredited of which take into account future cash flow; in fact, a potential buyer will pay the current value of the cash flow resulting from the valuation, even if the Cost Approach indicates a higher value.

Market Approach

The methods that refer to the market approach make it possible to assign the patent a value equal to the price paid on the market for the sale of that patent or for that of a similar one. This approach guarantees reliable results.

While the sum of the costs represents an indicator of value in the cost approach of the asset, in the market approach it is the price that represents an indicator of the value of the asset.

Under the *direct market value method* (*relief from royalty method*), the transaction price of the patent indicates its value, but the existence of an active market for the patent and the conditions of homogeneity of the asset, availability of buyers and sellers and public knowledge of prices are unlikely to occur.

The method calculates the licence fees saved, which would have been paid to a hypothetical licensor if the asset had not been produced internally. Royalties are fictitious licence fees that must be paid for the years for which you want to produce the item, estimating future revenues, the time frame and the discount rate to be applied.

The value of the intangible asset is therefore given by the presumed royalties discounted over time; since information on licensing agreements for similar assets is required. According to some authors (Reilly and Schweihs, 1998), this method is part of the market approach and according to other authors it is a hybrid approach (Anson and Suchy, 2005).

It will be necessary to add up the presumed royalties and update them over a time scale of at least 5-7 years, in any case not exceeding its maturity. It is necessary to find a royalty rate. In this regard, reference can be made to objective rules (royalty rate segmentation in some technological sectors, practical texts (Parr, 2007), sites or third parties that provide information about the rates applied in previous agreements) or subjective methods, based on the will of the managers or members of the Intellectual Property office.

According to the *analogy method*, the value of the patent is represented by the transaction prices of similar patents. The existence of an active patent market is necessary and the transactions should take place in conditions similar to the ones for the asset considered. This price must be made available on the market.

Again, it is difficult for these conditions to occur, since the information is not often public and if they are, a multiplier must be calculated to adjust the transaction prices to the asset considered; moreover, by definition, a patent protects a new and original innovation and it is therefore difficult to identify similar patents.

In fact, although each IPR asset can be treated as a tangible asset since it can be sold, licensed or transferred for free, the uniqueness of each of them makes it difficult to evaluate.

Income Approach

The methods that refer to the income approach allow a value to be assigned by measuring the net present value. This value can be measured considering the future cash flows of the patented asset.

The expected cash flows for the following years must be discounted at an appropriate rate and then added up. The income approach consists in converting the income into a sum of capital through the application of a discount rate; this sum, which is the current value of the technology at the time of the evaluation, requires some elements to be calculated: the cash flows that the holder expects to obtain in the future (this estimate is difficult especially in the initial phase of the pa tent's life); the duration of the flows over time (not certain until the patented asset will produce income); the discount rate (which should be adjusted considering the risk and uncertainty that change over time).

Regardless of the method adopted, the value of the patent is given by discounting the cash flows.

The *multi-period excess profits method* seeks to isolate the cash flows attributable to the patent by subtracting the ones (fictitious taxes) that are attributable to other assets from the entire cash flow. In fact, it is assumed that intellectual property only generates cash flows in combination with other assets.

This method calculates the fictitious taxes that would be paid for the exploitation of all the assets that act in combination with the patent (the royalties' method, on the other hand, calculates the fictitious taxes only for the latter). Therefore, the contribution of the other assets must be subtracted from the total cash flow, using appropriate valuation parameters.

The *incremental cash flow method* considers the income from both patented and unpatented technology. The difference between the cash flows for each period in the two situations represents the additional cash flow which, when discounted, represents the value of the patent.

In general, patentable innovations can be traced back to two macro-categories: process and product. In the first case there is a saving in production costs, while in the second case there is the possibility of applying a higher price and this will also determine higher sales volumes, even more if the product is new.

In the case of Cost Savings, the additional cash flow consists of the lower expense - compared to a competitor - incurred in the production process and this is linked to the technology covered by the patent (since a reduction in costs can also be due to the reduction of direct costs).

As for the Premium Price, a company charges a higher price for an innovative or even new item than a more obsolete one and this price will be even higher if this item is covered by a patent. The patent justifies the application of a higher market price since the patent has a cost.

The *direct cash flow method* (*greenfield method*) uses cash flows directly attributable to the asset in question, which are then discounted. The technology is not used in production processes but is licensed to third parties. The licence fees collected represent the future cash flows, which the owner (private or company) receives for having transferred the exploitation of the patent.

The *distributor method* (*disaggregated method*) is a variation of the multi-period excess profit method, sometimes used to measure customer-related intangible assets. Companies that are composed of various functions generate profits associated with each function. Information on the profit margins earned by distributors is used to estimate the excess earnings attributable to the customer in intangible assets.

Real Option Approach

The Option Pricing Theory (OPT) was developed in the financial field. An option is a right (not an obligation) to buy or sell an asset and therefore to choose whether to seize an opportunity, if desired. In the context of the evaluation of a patent, the latter is considered as a call option.

This approach is based on the work of Pakes (1986), in which it is highlighted how the rational economic agent chooses not to exercise the renewal option at time (optimal age) in which the expected benefits (given by discounted future returns but also from the discounted value of the option) would have become less than the sacrifices (renewal fees).

Similarly, the Real Options Approach (ROA) for the evaluation both of intangibles and firms (Damodaran, 2001; Trigeorgis, 1996) can be summarised as follows for the evaluation of a patent. If the discounted value of the net returns (given by the estimated cash flow and the estimated option minus the renewal fees, all discounted over time) is positive, the holder will renew the patent, exercising the option; if it is negative, the opposite will happen. The pay-off is as follows: V-X if V> X; 0 if V≤X.

X is the present value of negative cash flows (renewal fees) and V is the present value of positive cash flows (sales revenues). Therefore, the patent will be renewed if V> X and its value will be equal to V-X; the patent will not be renewed if V≤X and its value will be zero.

The concept of Net Present Value (NPV) is extended to consider the net value of opportunities beyond the discounted future flows (already considered in all income method approaches).

The opportunity to make a specific strategic choice can create value. The value of the patent is thus given by the present value of the cash flows and the present value of the development options; it is possible to distinguish them in some categories.

The options directly related to the patent project are the investment option, which will be exercised if V>X; the abandonment option, which will be exercised if X>V and the deferral option, which is a compromise between the decision to invest immediately and the one to abandon the initiative. It is also possible to identify other options, such as the growth option (possibility of investing in initiatives downstream of a project), the exchange option (possibility of undertaking alternative commercial methods) and the composite option (possibility of acquiring an option by exercising another option).

Indicators-Scoring/Rating/Ranking Approach

The *rating/ranking* method was developed by the expert in the evaluation and commercialisation of intellectual property, Richard Razgaitis (2002) and is one of the best-known qualitative methods.

This approach to patent evaluation is based on the choice of a series of qualitative indicators (for example, geographical coverage and age of the patent), considered important by management and which are individually evaluated with Likert scales; therefore, this non-monetary evaluation approach would suggest that patents that obtain a higher total score are to be considered more important than those that obtain a lower score. In particular, to reach the evaluation of patents, the following 5 steps must be followed:

- *scoring criteria*; this consists of the identification of the most indicators, that, in the perspectives of management, can contribute to evaluate the patents;
- *scoring system*; this consists of identifying the evaluation systems (with a score from 1 to 5, or from 1 to 7 as in the Likert scale or scales articulated on several levels or "high/medium/low" scales);
- *scoring scales*; this concerns the problem of the subjectivity of the evaluation (a non-objective scale in fact leaves space for the evaluator);
- *weighting factors;* this consists of attributing a weight to each indicator in order to assign a greater or greater less relevance to each of them;
- *decision table*; this consists of multiplying the score attributed to the indicator by the weight.

At the end of the five steps, the evaluation of the patents can be showed through radar graphs, which have the shape of a pentagon, in each vertex of which there is a parameter (the length of the line that joins the centre to the vertex is the score) and two-dimensional tables where each point represents a patent based on two criteria.

It is important that the indicators should be carefully chosen by intellectual property experts (e.g. management) based on the specific literature.

In the next paragraph, IPScore (Intellectual Property Score) will be explored in depth, a specific software that adopts the qualitative approach of the indicators.

6. IPScore

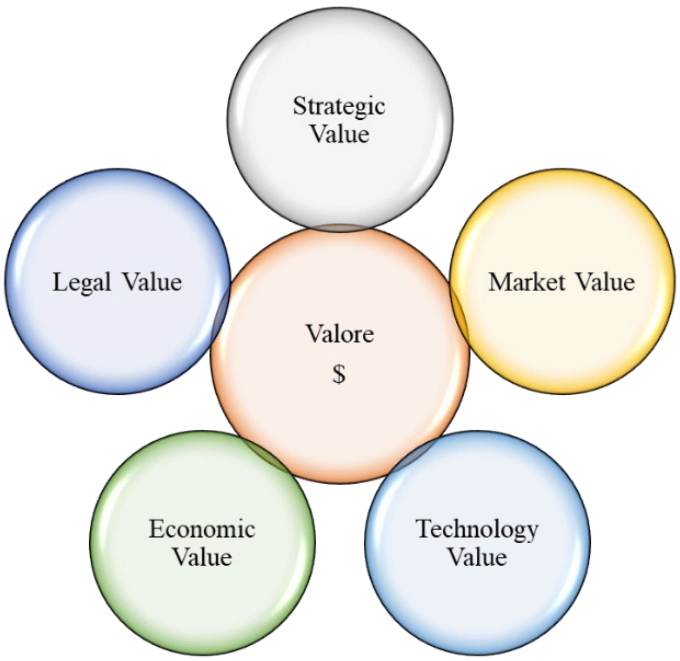
IPScore is a software tool developed for the evaluation of patents, technologies and research projects by the Danish Patent and Trademark Office and adopted by the European Patent Office (EPO).

This platform allows the evaluation of patents based on indicators belonging to five different dimensions, legal status, technology, market, finance and strategy.

IPScore is one of the most widely considered platforms in the literature on qualitative approaches to patent evaluation (see, among others, Ernst & Omland, 2011, Grimaldi *et al.*, 2018; Grimaldi and Cricelli, 2020; Song *et al.*, 2019, referred to in the review on the topic of "patent value", described in Chapter 1).

Specifically, the IPScore software considers a total of 40 non-monetary indicators, grouping them into five value dimensions, which can be represented as in Figure 2.2: technological value, legal value, market value, economic value and strategic value.

Figure 2.2- The model of the five dimensions of value of a patent



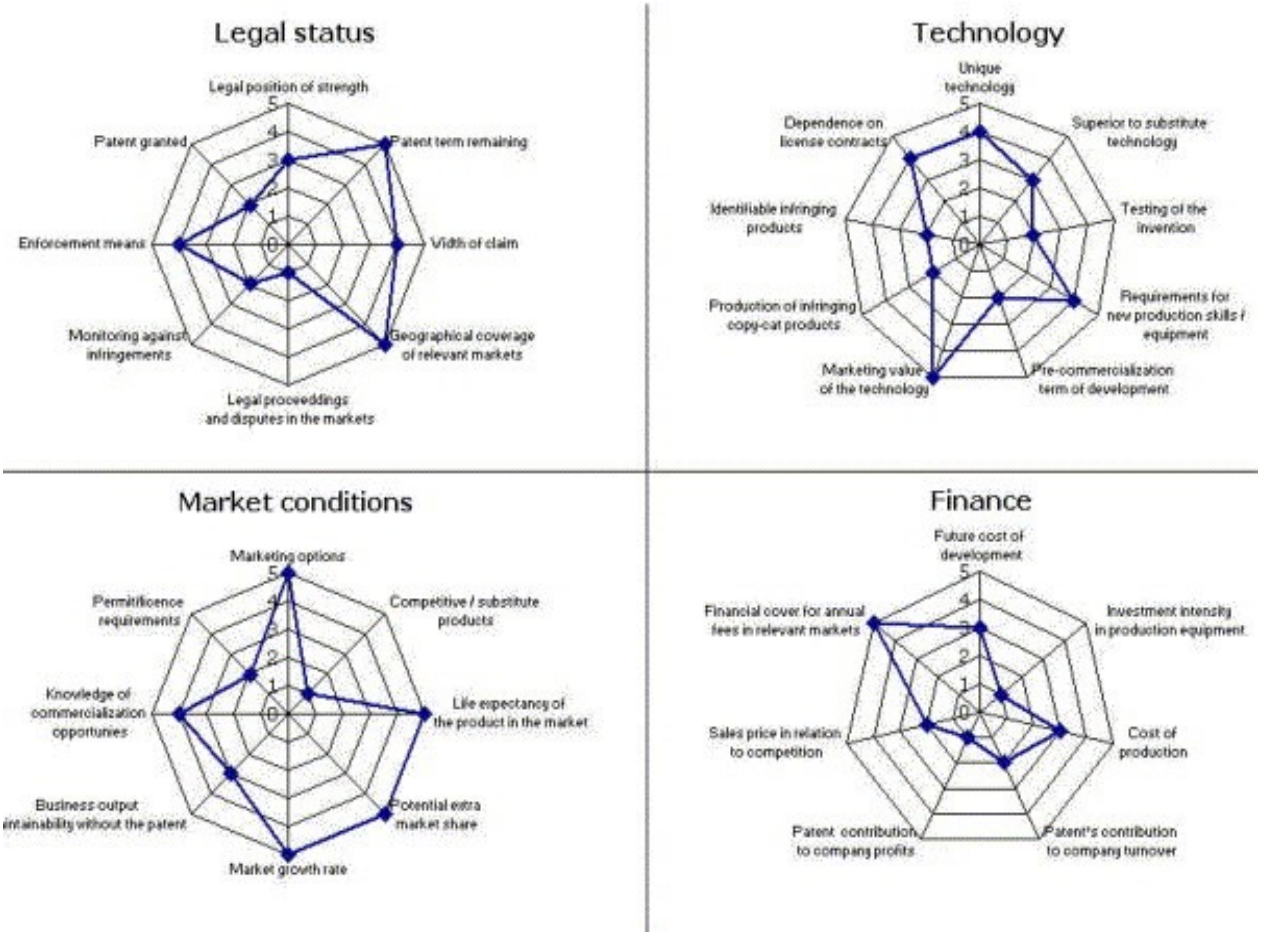
Source: personal elaboration.

In particular, by technological value we mean the purpose of the patent in terms of offensive and defensive capabilities; by market value we mean the earning potential and competitive market advantages that can derive from a patent; by technological value we mean the technological strength of a patent; by economic value we mean the actual economic value realised by the patent considering how the patent has contributed financially to its licensee, and by legal value we mean the legal protection of the patent and the stability of patent rights.

The indicators used in the IPScore are grouped into the 5 dimensions indicated and number 40 in total. It is possible to assign a qualitative score to each of them, from 1 to 5, based on how well each patent considered responds to the specific indicator in examination.

The following Figure 2.3 presents the indicators relating to the four dimensions, contained in the IPScore software: legal status, technological, market and finance.

Figure 2.3- Legal status, technological, market and finance dimensions, contained in the IPScore software



Source: Nielsen, 2004.

Therefore, in total, a patent can take on a total non-monetary numeric score ranging from 40 (40*1) to 200 (40*5); in the first limiting case the patent is not "good/strong" while in the second limiting case the patent is very "good/strong".

Conclusions

The objective of the chapter was to answer Research Question 2 (RQ2) of the doctoral thesis and referred to below:

- ✓ *RQ2: What are the main characteristics of the conceptual models used for patent evaluation in corporate contexts?*

We answered the research question through a critical review of the literature and by developing, in this regard, a summary layout that exemplifies the possible corporate choices regarding patenting,

highlighting the main advantages and disadvantages and the main characteristics of the quantitative and qualitative models of patent evaluation.

More in detail, we started from the idea that management can benefit from the considerations deriving from the evaluation of patents with a view to strategic exploitation, in order to increase the value generated by them.

From the analysis conducted, it emerged that the choice between patenting and secrecy represents only the first step of a much broader and multi-dimensional strategy, which we wanted to summarise step by step as follows: choice of patent protection as an alternative to secrecy to appropriate the value deriving from technological innovations, definition of a specific patent strategy for each patent and strategic management of the patent portfolio, which can be supported by considerations arising from the evaluation of individual patents.

For this reason, the various quantitative and qualitative models for evaluating patents have been described.

The quantitative evaluation approaches of cost, income and real options do not seem to offer an overall strategic vision of patents, but a proxy of value expressed in the form of a quantitative-monetary value for each of them, and such estimates are affected by the objective of evaluation itself; for example, the cost approach, based only on the costs required to achieve the patented innovation, provides only a minimum reference value, which should be compared with the value estimate resulting from the application of the income and/or costs approach. real options, which only consider future cash flows.

On the contrary, the qualitative approach of the indicators is considered the most suitable to support the internal management of patents in renewal or abandonment decisions, as unlike other quantitative approaches, it offers a broader and more complete vision of individual patents, providing an evaluation in the form of a total score of numerous indicators.

In particular, IPScore was analysed, as a multidimensional approach which, in addition to the technological characteristics of the patented innovations and the legal status of the patents, takes into account the economic-financial, market and, overall, strategic aspects that concern them.

However, from the description of the methods mentioned above, it seems to us that hybrid valuations, which combine both “pure” quantitative methods and qualitative (or rather qualitative-quantitative) methods, are the most complete methods since the monetary value would be complemented by

considerations relating to quality and the strength of the patent and, at the same time, the latter would be less affected by the subjectivity of the evaluation.

From the analysis of the literature, two further reflections and considerations emerged.

First of all, it seems to us that the tools or software proposed by the world of consultancy, specifically IPScore, are not easy to apply given the presence of numerous indicators to be interpreted and evaluated (40 indicators).

Secondly, by analysing the tools of the managerial sector, the prevalence of generic tools emerges, i.e. valid for all sectors and therefore the need to develop simplified patent evaluation models specific to sectors and companies.

Therefore, from the analysis conducted, a gap emerged in the literature on patent evaluation, namely the lack of a hybrid evaluation model, which integrates qualitative and quantitative approaches.

Given the aforementioned gaps, in the following chapters a conceptual patent evaluation model will be proposed, built by starting from the literature and with the contribution of the managers of the company being studied.

With the desire to provide a practical tool to the company, after development of the model, we will proceed with its application, which allows an initial validation test of the model in the sector to which it belongs.

SECTION 2

An explorative case study in a corporate context

CHAPTER 3- The case study Benelli Armi S.p.A.

CHAPTER 4- The processes of generating innovations and patents. The case study Benelli Armi S.p.A.

CHAPTER 5- Innovation and patenting as competitive purposes in the arms sector. The case study Benelli Armi S.p.A.

CHAPTER 6- A model for the evaluation of patents. The case study Benelli Armi S.p.A.

CHAPTER 3

The case study Benelli Armi S.p.A.

Introduction

The choice of patenting takes place with a view to appropriating the value deriving from technological innovations, avoiding wasting the efforts of the innovative process and competitors taking advantage of them, and at the same time with a view to commercial exploitation from a semi-monopolistic situation.

However, companies, even medium-large ones, do not always have a specific IP department and do not always adopt a strategic approach to patent management based on their knowledge and evaluation.

In theoretical Chapters 1 and 2 relating to the topic of patent management and evaluation, a systematisation and critical review of the studies on this topic was provided, since the literature on the subject was highly fragmented (Chapter 1) and a detailed analysis on strategic management analysing the quantitative and qualitative models of patent evaluation (Chapter 2) was lacking.

In light, on the one hand, of the gap in scientific knowledge on patent evaluation in corporate contexts and the growth of patent applications and, on the other hand, of the growing strategic nature of innovation and patenting for competitive purposes, especially for innovative companies, it is important to develop a strategic patent management model, which is useful for companies or that has practical utility, but is scientifically rigorous.

To this end, and in line with the industrial characteristic of Eureka PhD projects, which allows the PhD student to be placed within the company for a long period of time to analyse a topic of corporate interest, it was decided to create a single case study, which allows you to thoroughly investigate the company reality.

The creation of a single case study made it possible to collect data in order to develop the conceptual scheme in question, answering Research Questions 3 and 4 (RQ3 and RQ4), reported in the Introduction to the doctoral thesis.

The Benelli Armi S.p.A. case study it is described in Chapters 3, 4, 5 and 6 of the thesis.

In particular, this chapter allows us to pursue the following objectives:

(i) justify the choice of the single case study method, i.e. recalling its advantages but also its disadvantages and describing the investigation techniques used for its implementation;

(ii) carry out a historical analysis, describe the company organisation chart focusing on the role and composition of the Product Development Department, where the research activity was carried out and report the results that emerged from the investigation regarding the main innovative and patenting aspects and those regarding company strategy, reconstructing it in terms of vision, mission and values.

This chapter represents the preamble to the subsequent chapters aimed at answering the two research questions.

Chapter 4 describes the innovation strategy and policy; in Chapter 5 the results of the interviews relating to patent strategies and management are reported and lastly, in Chapter 6 the conceptual scheme and discussion of the case study are described.

This chapter is structured as follows:

(i) the first paragraph recalls the characteristics and subjects involved in the Eureka research doctorate path and the knowledge needs of the management of the co-financing company, which justify the empirical analysis conducted;

(ii) the second paragraph illustrates the reasons that led to the adoption of the single case study as a research methodology, recalling its advantages, but also its disadvantages;

(iii) the third paragraph illustrates the investigation techniques, which allowed the creation of the company case study;

(iv) the fourth paragraph recalls the methodological techniques adopted for the realisation of the first part of the case study, the results of which are presented in the chapter: participant observation, personal interviews and consultation of the website and company commemorative books;

(v) the fifth paragraph introduces the company, Benelli Armi S.p.A., through a historical analysis process and presents an overview of the company, in terms of innovation and patents;

(vi) the sixth paragraph illustrates the company strategy, in terms of vision, mission and values and presents the organisational structure of the company as a whole, focusing, in particular, on the role and composition of the Product Development Department, where the research activity took place.

Finally, a discussion of the results presented in this chapter is proposed as a preface to the entire company case study.

1. An introduction to the methodology: the Eureka Doctorate

Numerous themes were explored in depth during the three-year doctorate and were defined in an attempt to offer a valid research product from an academic point of view that was at the same time in line with the interests of the co-financing company.

This doctoral thesis contributes to filling these research gaps. In particular, the thesis work was carried out within the 35th Cycle of the PhD in "Global Studies, Economy, Society and Law", as part of the Eureka Project - PhD scholarships for innovation. This Project involves the active participation of the Marche Region, the University of Urbino "Carlo Bo" and companies from the Marche region that host the research projects. In this specific case, the company hosting the research project from which the doctoral thesis was developed is "Benelli Armi S.p.A."

More precisely, the Eureka Project is an intervention that the Marche Region is carrying out as part of the POR Marche FSE 2014/2020, in order to broaden the skills of young graduates and strengthen their employment potential, through a research doctorate.

Benelli Armi S.p.A, which represents the main object of study, operates in the production of semi-automatic repeating weapons and ammunition, within the macro-sector of precision mechanics and is based in Urbino (PU). In particular, during the thesis, a historical analysis will be provided, also in terms of numbers that decree its undoubted success and strategies and operational processes relating to innovation and patenting will be described.

In line with the industrial characteristic of this type of PhD project, the general objectives of the study have both an "academic" and "empirical" nature and consist, specifically, of filling a gap in scientific knowledge on the topic of the evaluation of patents in corporate contexts and in satisfying the knowledge needs of company management regarding the importance of innovation and patenting for competitive purposes, and in developing a model to satisfy the need for strategic management of company patents.

In the company, it was possible to rely on various research techniques, from participant observation within the Product Development Department where, among others, product innovations are developed and where patents are drafted (with the support of other corporate and/or external departments, as will be fully described later), to the formulation of questionnaires used to carry out direct interviews.

2. Research methodology and choice of single case study

The industrial nature of the research project, which involved a local company, made it possible to adopt a qualitative empirical research methodology; it consists in the creation of a single case study, which has numerous advantages but also disadvantages, referred to below.

The creation of business case studies allows us to understand "how" and "why" certain events occurred and is suitable for the study of new topics (Yin, 1981; 2018; Bonoma, 1985; Rashid *et al.*, 2019).

The concepts of innovation and patenting, understood as critical success factors of technologically advanced sectors, are of an extremely complex nature and require careful and in-depth analysis; in fact, exploring how and why innovation is planned, developed and implemented is only part of the corporate strategy that must be integrated with the way in which innovative research results are managed.

The single case study allows for in-depth investigation of the object of the study (Piekkari *et al.*, 2009) and guarantees the richness of the results (Dubois and Gadde, 2002) but reduces the possibility of generalising the results and increases observer bias (Vissak, 2010).

The industrial nature of the PhD project "imposes" the co-financing company as the main object of study, although some authors (Eisenhardt and Graebner, 2007) suggest intentional rather than random qualitative samples and the use of multiple case studies.

Despite this, Benelli Armi S.p.A. lends itself to a single case study for a series of reasons:

1) the *relevance and exceptional nature of the company in the sector, i.e. its innovative capacity*, through which it aims to be "always ahead" and on which it bases its competitiveness; the company, in fact, aims to be a leader in the sector through continuous innovation and this is demonstrated by highly successful products, such as semi-automatic shotguns, the company's core business and, more recently, over-and-under shotguns but also by the belonging to the other product families made such as shotguns, semi-automatic rifles, manual rifles and compressed air pistols;

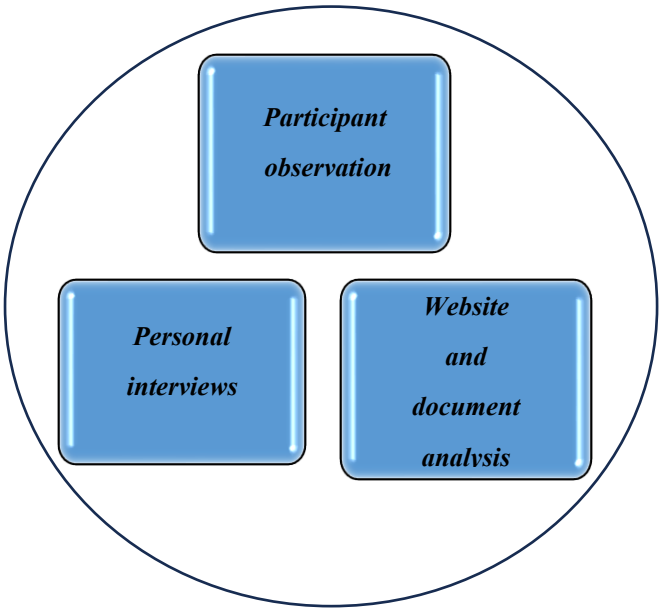
2) the *patent portfolio*, to protect technical innovations, is composed by 15 families (a family is made of the original patent and its nationalisations), 14 created internally and 1 purchased externally and 3 applications filed and still in the process of obtaining the patent; it is specified that according to a specific provision of the Property, "only product innovations are the subject of a patent, as they are considered more easily imitable by the competition compared to process and organisational innovations which, precisely, are not the subject of a patent". Furthermore, numerous ornamental models are also recorded;

3) the *exploratory nature of the study* to fill large gaps in the literature, which is not consolidated on the evaluation of patents in companies;

4) the *ease of access to company data,* which represents an important element in directing the methodological choice. The possibility of carrying out a Eureka doctorate also implies this significant advantage; in fact, access to sensitive data on patents, despite the sensitivity of the study, makes the company particularly suitable as the object of the single case study.

Therefore, this company case study offers a good opportunity to address the issues previously exposed and answer the research questions formulated following various methodological techniques: participant observation, the conducting of direct interviews based on semi-structured questionnaires and, aimed at selected respondents and the analysis of secondary data (Figure 3.1).

Figure 3.1- Methodological techniques to realise company case study



Source: personal elaboration.

These techniques made it possible to collect data and analyse them to develop the model for patent evaluation and finally apply it to Benelli Armi S.p.A.

3. Investigation techniques

The single case study was carried out through the use of different investigation techniques, mainly participant observation by myself and in-depth interviews. The analysis of secondary data, mainly website and company documentation, was added to these techniques, which allowed the collection of primary data.

The data used to draw up the case study were collected over three years, the duration of the PhD (2019-2022); the first year of the doctorate required 12 exams to be passed and did not leave time for the start of the case study but, overall, requested extensions led to an extension of a further year (2023), during which the investigation was conducted.

In particular, the participant observation lasted three years (2020-2023), as did the analysis of the website, the reading of commemorative books and the analysis of patent databases.

The personal interviews were carried out in the period October 2022-June 2023.

The various technical methodologies used to create the company case study are of a qualitative nature and allow us to investigate specific contexts and company realities. These techniques are described below.

Participant observation

Qualitative research guarantees "the privilege granted to close observation and the commitment to modelling one's data construction and analysis procedures on the characteristics of the object" (Cardano, 2011) and has taken the form of the participant observation technique.

Participant observation can be defined as follows: "a research strategy in which the researcher inserts himself a) directly and b) for a relatively long period of time in a specific social group c) taken in his natural environment, d) by establishing a relationship of personal interaction with its members e) with the aim of describing their actions and understanding, through a process of identification, their motivations" (Corbetta, 1999).

We experienced three years as a participant observer in the company's Product Development Department. This entailed the guaranteed constant physical presence in the workplace, interacting with some of the people involved in the study during their working day.

This methodological technique was one of the main methods of investigation, although it was affected by the limitations imposed by compliance with the rules during the Covid-19 pandemic, such as the mixed smart-working mode and the impossibility of participating in trade fair events.

The three-year experience, in fact, allowed data and information to be collected over a long period of time, allowing us to understand social actions and interactions at a functional and operational level.

However, it immediately emerged that simple observation could not be sufficient to fully understand the topics being studied.

The reconstruction of the corporate strategy, the processes for generating the different types of corporate innovations (essentially product, process and organisational) and the patent generation processes, understanding the management's perceptions regarding the importance of innovation and patenting in the relevant sector and the analysis of problems regarding the identification of strategic and non-strategic company patents, specifically required in-depth analyses.

The comparison between what emerged from the analysis of international literature on the topic of the evaluation of individual patents and their strategies and management with the data and information collected during the experience as a participant observer was therefore the basis for the drafting of two different semi-structured questionnaires, administered during personal interviews.

The questionnaires were also constructed through a discussion with the Product Development Manager and were the subject of preliminary testing through a couple of pilot interviews, which allowed the questions and their expository sequence to be refined.

Personal interviews

In fact, alongside participant observation in the workplace, the method used to gain knowledge of research, which has always been more widespread in the world of social sciences, is questioning and consists of "an interview with one or more subjects, specifically selected, so that they respond to a series of questions, previously set by the researcher, with the aim of knowing the interviewee's thoughts regarding those themes that the researcher has identified as the object of his research" (Natale, 2007).

The basic objective of the interview is therefore to know the thoughts of the interviewed subject, to understand their attitudes and their way of behaving towards the topics being studied by the researcher (Natale, 2007).

Since the objective was to carry out an in-depth analysis of innovation and patenting at company level, the personal interview technique seemed to be the most suitable.

Therefore, the company was granted the opportunity to personally conduct interviews with various managers, selected on the basis of their roles and skills (technical and/or commercial), who were capable of providing information on the main topics under investigation. In particular, the interviews are based on two semi-structured questionnaires, composed of closed/standardised questions, which use rating scales from 1 to 5 or in percentage terms, and open/free response questions.

The questionnaires were issued to this company only.

The first questionnaire (Questionnaire 1-Strategy, Innovation and Patenting) was created with the aim of investigating the company strategy, in terms of mission, vision and values and its approach to innovation and patenting.

The second questionnaire (Questionnaire 2 - Key Success Factors and Patent Evaluation) was created with the aim of understanding whether innovation and patenting are actually considered Key Success Factors (KSFs) of the sector and of identifying the criteria considered most important for the evaluation of patents and, on the basis of these, of categorising company patents into strategic and non-strategic, as a support for management's renewal decisions.

The protocols used for the interviews relating to Questionnaire 1 (Table 3.1) and Questionnaire 2 (Table 3.2) are reported below. For the two complete questionnaires, please refer to the Appendix.

Table 3.1- Interview protocol on Questionnaire 1 Strategy, Innovation and Patenting

Sections of the questionnaire 1	*Topics covered*
SECTION A- PRESENTATION OF THE COMPANY: FOCUS ON INNOVATION AND PATENTING	*Description of the company in numbers: employees in innovative departments, sales performance of new products, innovation and patents*
SECTION B - CORPORATE STRATEGY	*Description of vision, mission and company values*
SECTION C- INNOVATIVE CORPORATE STRATEGIES	*Understanding of the company's approach to innovation at a corporate and business level*
SECTION D- CORPORATE INNOVATION GENERATION PROCESSES	*Understanding of innovation generation processes at a functional level, in terms of roles, activities, resources and timing*
SECTION E- CORPORATE PATENT STRATEGIES	*Understanding the company approach to patenting at a corporate level*
SECTION F- CORPORATE PATENT GENERATION PROCESSES	*Understanding the patenting process at a functional level, in terms of roles, activities, resources and timing*

Source: personal elaboration.

Table 3.2- Interview protocol on Questionnaire 2 Key Success Factors and Patent Evaluation

Sections of the questionnaire 2	*Topics covered*
SECTION A- PRESENTATION OF THE INDUSTRY: KEY SUCCESS FACTORS AND POSITIONING OF THE COMPANY	*Investigation of Key Success Factors, positioning maps, innovation, advantages/disadvantages of patenting in the sector*
SECTION B- DRIVERS OF INNOVATION, TYPES OF INNOVATIONS AND ADVANTAGES AND DISADVANTAGES FROM PATENTING IN THE INDUSTRY AND IN THE COMPANY	*Investigation of the drives for innovation, the degree of novelty of the innovations and the advantages and disadvantages deriving from patenting*
SECTION C - SURVEY OF COMPLIANCE OF PATENTED PRODUCTS THE KEY SUCCESS FACTORS OF THE ARMS INDUSTRY	*Identification of strategic patents for the company's operations*
SECTION D- SURVEY OF FORECAST TRENDS IN PATENTED PRODUCT TURNOVERS	*Identification of performing patents, important for the company from an economic and financial point of view*
SECTION E- SURVEY OF DIRECT COMPETING PRODUCTS	*Identification of performing patents, important for the company from a market point of view*
SECTION F- SURVEY OF TRENDS IN PATENTED PRODUCT TURNOVERS AND PATENTING EXPENSES	*Identification, among the patents to be monitored, of those that should not be renewed*

Source: personal elaboration.

A total of ten interviews lasting approximately two hours each were conducted.

Table 3.3 is shown below, which summarises the following information on the respondents: role held in the company, specific competence, questionnaire(s) to which the interviewee responded, date and duration of the interview with each of them (Table 3.3).

Table 3.3- Selected respondents, role held in the company, specific competence, questionnaire(s) to which the interviewee responded, date and duration of the interview with each of them

Respondent Number	***Role held in the company***	***Area competence***	***Questionnaires to which the interviewee responded***	***Interview date***	***Interview duration***
1	President	Technical and Commercial	1 and 2	29/06/2023	2 hours
2	Plant and Industrial Manager	Technical	1 and 2	14/11/2022	2 hours
3	Product Development Manager	Technical	1 and 2	21/10/2022	2 hours
4	Prototyping Manager	Technical	1 and 2	22/11/2022	2 hours
5	Treatment and Quality Assurance Manager	Technical	1	17/11/2022	1 hour and 30 minutes
6	Industrialization Manager	Technical	1	22/11/2022	1 hour and 30 minutes
7	Head of Sales	Commercial	1 and 2	22/12/2022	2 hours
8	Sales Manager, Italy	Commercial	1 and 2	28/11/2022	2 hours
9	Sales Manager, International	Commercial	1 and 2	05/12/2022	2 hours
10	Marketing Manager	Commercial	1 and 2	22/12/2022	2 hours

Source: personal elaboration.

The ten interviewees were involved in the sections of the interview of their specific competence.

Therefore, the following Tables specifically report the respondents for each section of Questionnaire 1 (Table 3.4) and Questionnaire 2 (Table 3.5).

Table 3.4- Selected respondents for each section of Questionnaire 1

	Selected respondents									
	President	Plant and Industrial Manager	Product Development Manager	Prototyping Manager	Treatment and Quality Assurance Manager	Industrialization Manager	Head of Sales	Sales Manager, Italy	Sales Manager, International	Marketing Manager
Sections of the questionnaire 1										
SECTION A- PRESENTATION OF THE COMPANY: FOCUS ON INNOVATION AND PATENTING			o	o	o	o		o	o	
SECTION B - CORPORATE STRATEGY	o	o	o	o			o	o	o	o
SECTION C- INNOVATIVE CORPORATE STRATEGIES	o	o					o			
SECTION D- CORPORATE INNOVATION GENERATION PROCESSES			o	o	o	o				
SECTION E- CORPORATE PATENT STRATEGIES	o	o	o	o						
SECTION F- CORPORATE PATENT GENERATION PROCESSES			o							

Source: personal elaboration.

Table 3.5- Selected respondents of Questionnaire 2

	Selected respondents							
	President	Plant and Industrial Manager	Product Development Manager	Prototyping Manager	Head of Sales	Sales Manager, Italy	Sales Manager, International	Marketing Manager
Sections of the questionnaire 2								
SECTION A- PRESENTATION OF THE INDUSTRY: KEY SUCCESS FACTORS AND POSITIONING OF THE COMPANY	o	o	o	o	o	o	o	o
SECTION B- DRIVERS OF INNOVATION, TYPES OF INNOVATIONS AND ADVANTAGES AND DISADVANTAGES FROM PATENTING IN THE INDUSTRY AND IN THE COMPANY	o	o	o	o	o	o	o	o
SECTION C - SURVEY OF COMPLIANCE OF PATENTED PRODUCTS THE KEY SUCCESS FACTORS OF THE ARMS INDUSTRY	o	o	o	o	o	o	o	o
SECTION D- SURVEY OF FORECAST TRENDS IN PATENTED PRODUCT TURNOVERS								o
SECTION E- SURVEY OF DIRECT COMPETING PRODUCTS								o
SECTION F- SURVEY OF TRENDS IN PATENTED PRODUCT TURNOVERS AND PATENTING EXPENSES	o	o	o	o	o	o	o	o

Source: personal elaboration.

To facilitate understanding of the questions, on the one hand, and on the other to allow the interviewee to provide rich and detailed answers, the researcher clarified any doubts, listened carefully and asked further questions, when necessary, in order to obtain additional feedback.

The use of multiple informants helps reduce interviewee bias (Yin, 2018), mitigating the potential biases of each individual interviewee. Furthermore, the information collected through interviews was confirmed by managers and other sources (Santos and Eisenhardt, 2009).

All interviews were conducted in Italian, recorded, transcribed and translated into English.

With regards to the analysis of the data collected, we proceeded as follows. The answers to the interview questions were read carefully and key themes were highlighted; a content analysis was therefore carried out using classic coding to examine the data collected via the interviews. According to Creswell (2012), a good content analysis describes the thematic content of the interviews, using transcriptions that allow common themes in the texts to be identified.

During this phase, we identified codes that are significant "statements", which mainly describe the company strategy, innovative and patent strategies and processes.

Some issues have been explained and interpreted by myself, as they are implicit in many managers' statements, in order to identify the most important criteria for the development of the patent evaluation model.

Furthermore, the final reports of each interview were sent to the interviewees for approval and possible modifications, in order to improve the validity of this study, and were then translated into English.

Website and document analysis

To supplement the interviews, we collected further information from other sources, such as the company website and numerous other data were also collected through consultation of company documents and presentations.

In particular, secondary data was collected from the website, financial statements, company brochures, archival documentation and company publications.

The analysis of this data allowed the statements made in the interviews (Woodside and Wilson, 2003) to be cross-checked (triangulated), revealing a high level of coherence.

Therefore, the primary data collected mainly through participant observation and the various direct interviews conducted with the President and the main managers of the company, in order to reduce the biases of the interviewees (Yin, 2018), were compared and integrated with the secondary data collected through other data sources (Gibbert *et al.*, 2008).

The content analysis using classical coding to examine the data collected through interviews (Creswell, 2012) represented an excellent basis for the reconstruction of the business processes that we wanted to analyse, supported by data from other sources.

For data triangulation, we collected information from other sources, such as the company website and numerous other data were provided by documents and presentations by the people interviewed, in order to reduce the probability of misinterpretations and to consider more points of view (Ghauri, 2004).

4. Benelli case part 1: a methodological premise

Below, the methodological techniques adopted for the realisation of the first part of the case study are explained, the results of which, relating to history, organisational chart, overview of innovation and patenting and corporate strategy in Benelli Armi S.p.A., are presented in the chapter.

These results were achieved through the use of the different methodological techniques described in paragraph 3.

In particular, paragraph 5 in the chapter describes the history of the company which was built by analysing the data collected on the website and in corporate commemorative books and participant observation and describes the company's innovative and patenting capacity, as a result of the analysis of section A of Questionnaire 1. Paragraph 6 describes the company strategy, cross-referencing the data from the interviews in section B of Questionnaire 1 with the data collected in the website and in company commemorative books and illustrates the company organisation chart, the result of the analysis of the data provided by the Technical Director, focusing attention on the Product Development Department where I undertook my research activity.

A detailed description of the single case study method and the investigation techniques used has been provided in the previous paragraphs.

Sections A and B of Questionnaire 1 are reported below (Table 3.6), indicating the respondents involved in the interviews. For the complete interview protocol, please refer to paragraph 3 of this chapter, while for the complete Questionnaire 1, please refer to the Appendix.

Table 3.6- Sections A and B Questionnaire 1 Strategy, Innovation and Patenting

Questionnaire sections	***Selected respondents***
SECTION A- PRESENTATION OF THE COMPANY: FOCUS ON INNOVATION AND PATENTING	Product Development Manager; Prototyping Manager; Treatment and Quality Assurance Manager; Industrialization Manager; Sales Manager, Italy; Sales Manager, International.
SECTION B - CORPORATE STRATEGY	President; Plant and Industrial Manager; Product Development Manager; Prototyping Manager; Head of Sales; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

Source: personal elaboration.

5. History and strategic positioning of Benelli Armi S.p.A.

Benelli Armi S.p.A. was founded as a joint stock company in 1967 from an idea developed in 1940 by the Benelli brothers, owners of Benelli of Pesaro, a famous motorcycle manufacturing company. The Benelli brothers, who combined a vocation for fine mechanics with a great passion for hunting, believed that the evolution of hunting rifles was moving in the direction of repeating weapons. Thanks to the valid support of Bruno Civolani, an ingenious designer from Bologna, who managed to define a weapon of revolutionary conception, an extraordinary hunting rifle was created which did not exploit a traditional gas mechanism but the inertia of masses.

A lively and continuously growing company that invests in research and design: new highly innovative and high-tech products have contributed over the years to strengthening the prestige and diffusion of the Benelli brand in the hunting and sporting weapons market, thanks also to the strategic choice of offering a range of products considered today to be the widest available on the semi-automatic market.

The company's production site is located in Urbino (PU), Via della Stazione n. 50 (Figure 3.2). This site covers an area of approximately 66,000 m^2. The indoor area intended for production extends for approximately 23,000 m^2.

Figure 3.2- The company Benelli Armi S.p.A.

Source: company material.

Throughout its history, Benelli Armi S.p.A. has been constantly committed to keeping up with the times by focusing on technological innovation, both at product and process level. Great attention has been paid to the professional growth of all staff, in order to allow the development of products and services that place the company at a very high level in the sporting and defence weapons market.

All processes are carried out under the careful vision of the Quality Guarantee, which works to ensure that all activities comply with the company quality system, organisational and operational capabilities.

Continuous innovation, research and development of new products and new technologies, quality and manufacturing excellence are the main objectives aimed at by Benelli: it is by following these principles that products are designed and manufactured that combine mechanical precision and refined design. Benelli Armi S.p.A. has been gaining knowledge for over forty years now in the sector. The high technological standard of the company's production makes it necessary to constantly update production techniques and tools; the company, in fact, has always been very attentive to the advantages that research can bring both in terms of product and production improvement and in terms of market developments.

In addition to research aimed at overcoming problems related to production, the company plans much more laborious research in the medium and long term, precisely because the need to be constantly updated on the development of the needs of the various markets in which it operates is a priority.

The entrepreneurial strategy of Benelli Armi S.p.A. has always had the effort to anticipate market expectations and consumer demand as its basic principle, making innovation a priority.

Over time, concepts such as design and art have acquired increasing importance (Figure 3.3). The elegance of the lines, the quality of the finishes, the high quality of the materials, the beauty and warmth of the wood grain: every detail bears the Benelli signature. Semi-automatic precursors of a new style, exciting, capable of fascinating and striking the collective imagination.

Figure 3.3- Hall of the company

Source: company material.

Benelli currently covers all the world markets in which it is possible to operate. The main market for Benelli, but more generally for all arms manufacturers, is the USA, which on average covers 70% of Benelli's turnover. The USA is consequently the market where competition is fiercest, both in terms of prices and number of competitors, over 200.

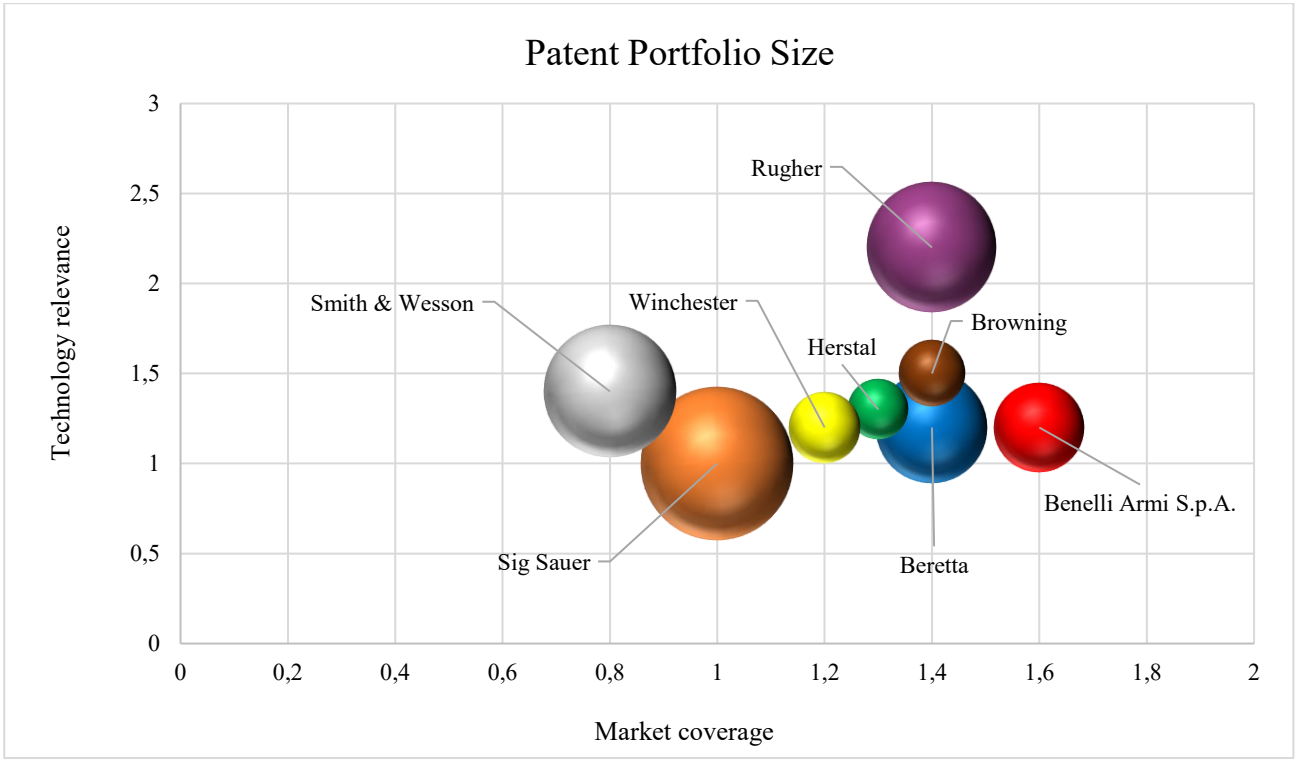
Benelli is the leader of the USA semi-automatic market in volume, with 30% of the market share and above all in value, with 44% of the market share, thanks to its value proposition composed of the widest range of products offered on the market, which is today the most complete on the world market (1.141 different rifles in the catalog).

The value proposition of Benelli combines the breadth of the range with the quality of the design, manufacturing and service which places Benelli products at the top of the value pyramid.

Overtime, most of Benelli's competitors have chosen to reposition their offer in the low-medium price range, favouring volumes over margins.

Benelli's competitive strategy was to improve quality and therefore the price of the offer year after year, in contrast to its competitors and this company strategy has led to the development of numerous innovations, covered by patents. Below an overview of the strategic positioning of the company and its main competitors is presented, according to the market coverage (i.e., the breath of the global markets that a family of patents protects) and the technology relevance (i.e., the importance that a family of patents has for the technologic development) of the patent portfolios (Figure 3.4); the size of the bubbles represents the size of each patent portfolio.

Figure 3.4- An overview of the patent portfolios of the main companies of the arms sector

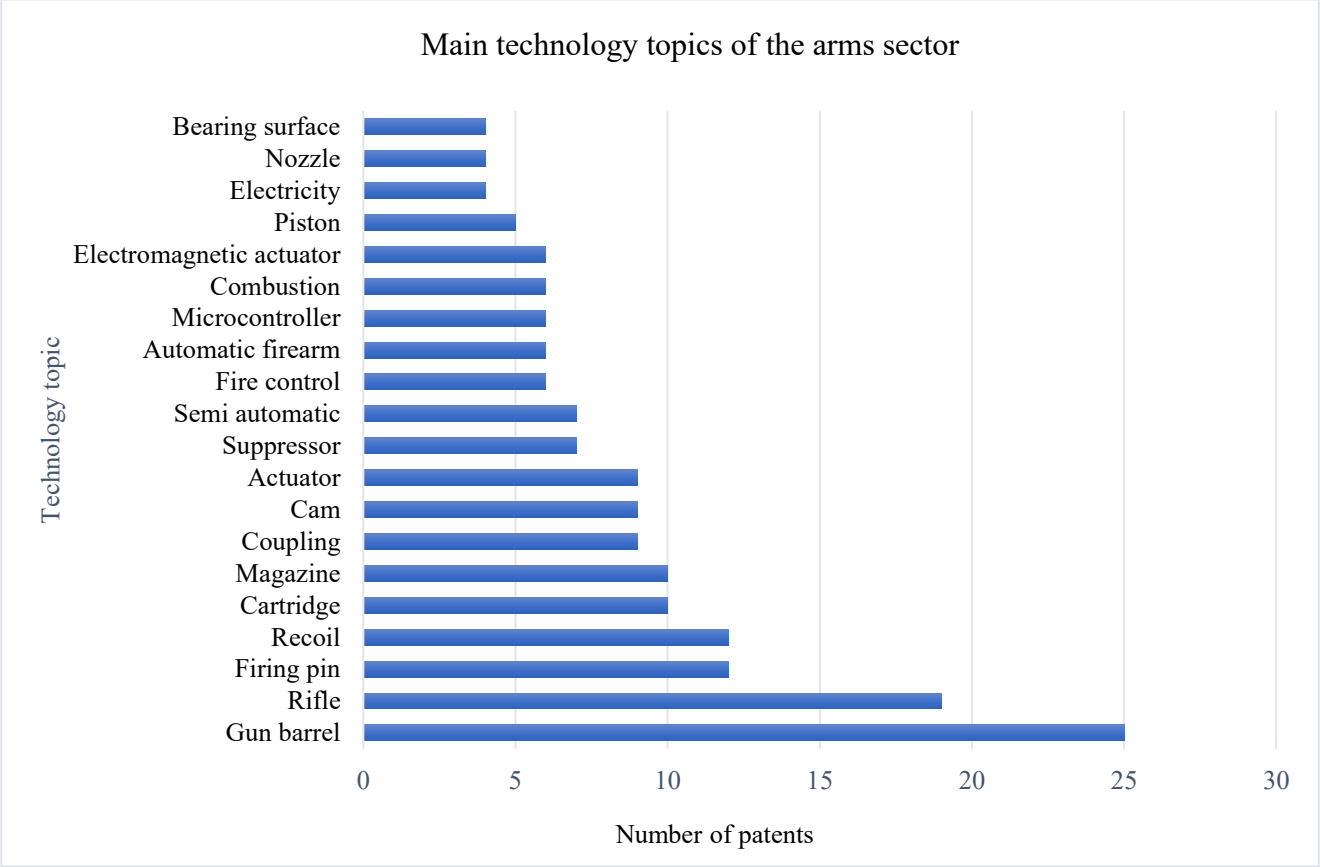


Source: personal elaboration.

Benelli Armi S.p.A. and Beretta (the parent company of Benelli Armi S.p.A.) own wide patent portfolios with a high market coverage but a low technology relevance.

The continuous innovation of the company is focused on the actual main technology topics of the arms sector, reported below (Figure 3.5).

Figure 3.5- Main technology topics of the arms sector



Source: personal elaboration.

Benelli Armi S.p.A. represents an undoubted example of success in its territory, to which it has a great attachment, as can be immediately seen from the names of the products, for example, Raffaello, which takes its name from the artist from Urbino known as one of the greatest exponents of the Renaissance and 828U, the United Nations for Educational, Scientific and Cultural Organization (UNESCO) code attributed to Urbino as a World Heritage Site.

The company is also involved in numerous initiatives to enhance the environment in a broad sense and the local territory specifically, and in the enhancement of its employees, who can annually

participate in a company clay pigeon shooting competition, given the wide range of weapons not only for hunting but also for sports.

Benelli Armi S.p.A. represents the main object of the study and presents itself as an extremely suitable reality for the purposes illustrated for numerous reasons which can be traced back to two main reasons: its innovative capacity and patent portfolio.

The data and information collected as a participant observer and by consulting the company website and company commemorative books have, in fact, highlighted a strong innovative and patenting capacity and a shared company strategy in the Product Development Department, in terms of mission, vision and values.

Through its innovative capacity, the company aims to be "always ahead" and bases its competitiveness on this. The company, in fact, aims to be a leader in the sector through continuous innovation and this is demonstrated by highly successful products, such as semi-automatic shotguns, the company's core business and, more recently, over-and-under shotguns but also by belonging to the other product families made such as shotguns, semi-automatic rifles, manual rifles and compressed air pistols.

To protect technical innovations, the patent portfolio is made up of 15 families (14 created internally and 1 purchased externally) and 3 applications filed and still in the process of obtaining the patent. Upon specific provision of the Property, "only product innovations are the subject of a patent, as they are considered more easily imitable by the competition compared to process and organisational innovations which, precisely, are not the subject of a patent". Furthermore, numerous ornamental models are also recorded.

The new products in the portfolio, whether patented or not, are almost always successful on the market and guarantee an important part of the turnover every year.

The investigation conducted through interviews focused on the collection of further data and information, in order to delve deeper into what had already been collected, and on the analysis of the company strategy.

It emerged that approximately 20%-30% of the turnover is recorded with the new products in the portfolio, although the specific reference markets must always be considered.

Despite continuous innovation that requires the development of new ideas, the trend in the number of employees in the innovative departments (Product Development, Prototyping, Heat and Surface

Treatments and Industrialisation) has remained constant over the last three years; in general, except for some small variations, the number of employees has not changed, although there is a constant turnover of staff.

During the year, various innovative ideas are developed, which in turn can translate into real inventions. Of these only 1 or 2 out of 10 do not translate into innovations, i.e. into new products and in turn only 1 or 2 innovations are not protected by a patent, because, for example, the innovative content is not so relevant as to require a patent or according to a specific provision of the Management, although the guideline is to patent any innovation that has minimal innovative content.

6. Corporate strategy and company structure

The company strategy is expressed in terms of vision, mission and values.

In particular, it emerged that vision, mission and values are shared within the Product Development Department and, specifically, by the respondents to the questionnaire.

The President believes that Benelli, being a manufacturing company, "does not depend on huge investments in specific activities but on the quality of the manufacturing carried out"; the mission is a set of various elements such as clarity, quality of manufacturing and the constant search for excellence; the company values are those of the well-being and valorisation of employees since "people who feel well work well".

Also, with regard to the Technical Area, it emerged that "the mission is a set of different elements, such as technology (continuous innovation), R&D, quality and manufacturing excellence (as can also be read on the company website); this occurs with a view to customer satisfaction as a product and as a service, following the values of respect for workers and the valorisation of human resources and the environment, through the development of various social initiatives".

As regards the Commercial Area, it emerged that "the mission is, in line with a more commercial and marketing vision, to deliver to the market an innovative, aesthetically beautiful product, in step with the times and differentiated from those of competitors (mechanics and aesthetics), following the values of respect for workers and valorisation of human resources and the environment, through the development of various social initiatives and respect for competitors, in terms of correctness and non-imitation". It also emerged that "the company aims to move from a brand recognised in semi-automatic rifles to a brand recognised in all weapons produced (moving from "premium semiauto brand" to "premium firearm brand")".

The vision is expressed by the slogan “Always a step ahead” and consists in offering high quality products, higher than that of competitors, in line with the brand's perception of excellence.

All respondents believe that the company strategy has never changed over time and that it is universally recognised in all company departments, since all workers are part of implementing it.

The company aims to be a leader through innovation, which essentially takes the form of continuous incremental innovations, seeking to satisfy the market’s continuous needs, rather than radical ones (Ferrucci, 2020) and we have tried to understand whether this reflects the company strategy company, in line with increasingly faster market dynamics.

In this regard, the President believes that “the company has never developed radical innovations for the sector, but has always expanded the range of its product portfolio”.

As regards the Technical Area, opinions are conflicting; there are those who believe that “the development of incremental rather than radical innovations depends on the company’s insufficient internal capacity to develop the latter, in order to satisfy customers and, therefore, this is not linked to the faster dynamics of the market”; in fact, considering the Vinci semi-automatic rifle, taken as an example in this sense by the President and the respondents belonging to the Technical Area, it emerged that it has advanced and particular mechanics, despite being launched in 2007, so much so that it has no direct competitors, incorporating much more than incremental innovations, which however have not been adequately perceived by customers.

On the contrary, there are those who believe that “market dynamics are actually faster, in the sense that markets are more customised, i.e. requests are faster but also more personalised and this increases incremental innovations/improvements and reduces radical innovations, which instead require much more time in their development”.

The significant increase in the number of products in the catalogue in recent years therefore depends on increased demands from the market (which requires, for example, all calibres of rifles); in fact, it is necessary to consider that a single product has different configurations/versions, which coincide with different and as many projects and that, at the time of launch, the product has n-configurations/versions/projects available. Increased customisation leads to more products and designs but reduces quality.

This aspect is not the only one to consider; in fact, for some years now, lots that are half or a third smaller than the previous ones have been accepted; this reduction is an input from the President which

depends on his choices in conjunction with those of the Managers but also on the faster dynamics of the market, i.e. on the fact that consumers demand new constant improvements.

Last but not least, it is necessary to consider the fact that, for some years now, the company has had a new brand (Franchi) compared to the past.

Also, with regards to the Commercial Area, according to those interviewed, “the more time progresses, the more difficult it becomes to make radical innovations, regardless of faster market dynamics and the company’s capabilities”. In particular, the following emerged.

The last radical innovation, or at least that was more than incremental, occurred with the Bolt Action rifle, but more than a radical innovation it can be seen as the satisfaction of a new market segment. In recent years Benelli has expanded its product portfolio (with the 828U over-under for 5/6 years and with the Bolt Action rifle for 2 years) to maintain the market, given that the semi-automatic market is declining. The company is now complete in offering hunting and sporting weapons; having started to serve new businesses and, consequently, new segments. These projects need to be branched out through the development of the entire range of 828U and Bolt Action with different calibres and woods.

Generally speaking, the market is not very innovative, more stagnant; it is the company that creates demand, providing input with new products, launching new products that the consumer then wants. In this sense, the Bolt Action represented the largest slice of the market, also considering that semi-automatics are subject to greater restrictions/blocks in various countries (a category considered more dangerous).

In line with this thought, the radical innovations of recent years are considered radical for Benelli, but not for the market since the company wants to be recognised as a brand and this determines innovations, definable as “semi-radical”, not only in semi-automatics but also in over-and-unders, in order to become a global point of reference in firearms. This responds to the company philosophy of coming out of its shell.

Benelli Armi S.p.A. is 100% owned by Beretta Holding. The Group is today an authentic global player in its sector thanks to its production sites on all five Continents, confirming the historic international vocation of the company which has always considered the world as its natural space for action. The Group closed the 2022 financial year with a consolidated net turnover of 1.4 billion euros and employs over 6.500 people.

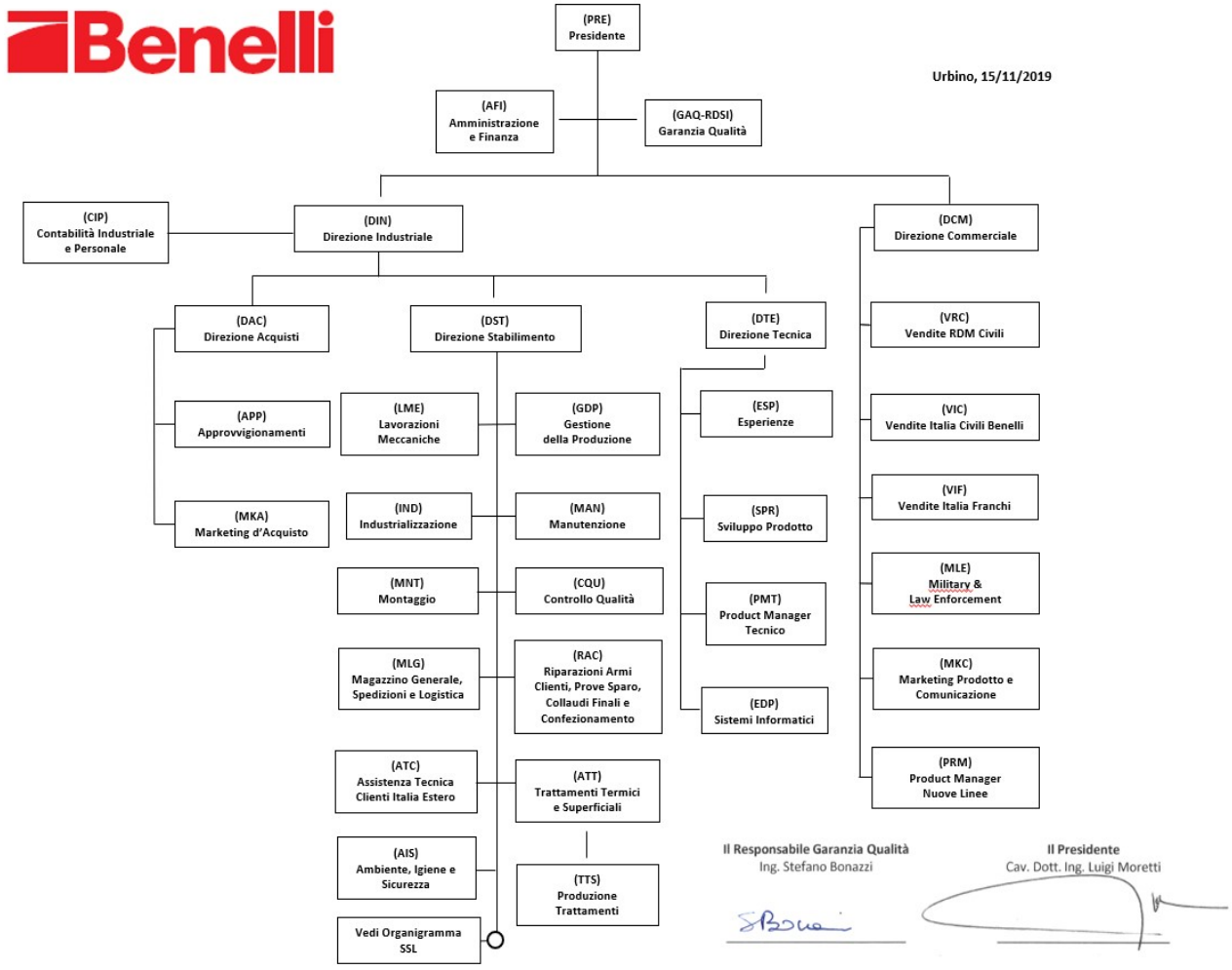
Within the Group, Benelli Armi S.p.A. plays an important role and has the purpose not only of adopting the guidelines but also of providing other associated companies with technical-production, design, study and research supports. Internally, the company operates through an organisational structure led by a board of directors while employees are organised according to a function structure, which is divided into departments:

- Industrial Management, which includes Purchasing Management, Technical Management and Plant Management;
- Sales Management.

This structure is flexible and thus responds to the communication needs between individual departments thanks to the coordination provided by liaison figures. The production department is divided into sub-departments, headed by highly qualified professional figures, each with knowledge of the entire production process and therefore interchangeable according to the production needs dictated by market demand.

Below, the company organisation chart is shown (Figure 3.6), focusing on the characteristics of the research and development function in the company, i.e. the context in which innovation is carried out and which then follows the patenting activities (essentially the office where I worked in the three-year period).

Figure 3.6- Company organisation structure



Source: company material.

Conclusions

Chapter 3 introduces the case study that is the subject of the thesis which is developed in 4 chapters (3, 4, 5 and 6) and that allows us to answer the research questions RQ3 and RQ4.

Specifically, this chapter was developed with the aim of describing the reasons that led to the adoption of the single case study, i.e. recalling its advantages, but also the disadvantages and the techniques that allowed its creation as well as describing the results relating to part 1 of the Benelli case study.

The case study is a research method consistent with the peculiarities of the Eureka Research Doctorate, which involves permanence in the company, allowing for the in-depth investigation of specific contexts of the co-financing company.

The writing of the case study was possible thanks to the adoption of various investigation techniques, such as participant observation, in-depth interviews and the analysis of secondary data.

The first results emerging from the analysis of primary and secondary data collected through various methodological techniques were presented, in order to offer an overview of innovation and patenting in the company and the reconstruction of the company strategy, in terms of vision, mission and values.

It emerged that, through its innovative capacity, the company aims to be "Always a step ahead" and bases its competitiveness on this capacity and the rich portfolio of patents guarantees the appropriation of the results.

The company pursues objectives of continuous innovation and patenting and this occurs on the basis of the stimuli and strategic vision of the leader, who carries out his role as President, inspiring collaborators to drive change.

The new products in the portfolio, whether patented or not, are almost always successful on the market and guarantee an important part of the turnover, every year. The trend in the number of employees in the innovative departments (Product Development, Prototyping, Heat Treatments and Superficial and Industrialisation) has remained constant over the last three years and the various innovative ideas almost always translate into real innovations, almost all of which are patented.

This success, demonstrated by constantly growing turnover numbers, is possible thanks to a corporate strategy shared in the department and, specifically, by the respondents to the questionnaire, i.e. a shared mission, vision and corporate values.

The vision, "always ahead", is maintained and pursued every day through sharing the mission, based on technology (continuous innovation), R&D, quality and manufacturing excellence (as can also be read on the company website) and values, such as respect for workers and the valorisation of human resources and the environment.

This chapter represents the preamble to the subsequent chapters aimed at answering the two research questions.

In particular, during Chapter 4, the results of the analysis carried out through participant observation and personal interviews will be reported, conducted in order to investigate innovative and patent strategies and to understand how they are defined and implemented at different business levels(?), corporate, business and functional.

This investigation is preparatory to the one presented in Chapter 5, which will try to understand whether, in a company that declares itself to be an innovation leader also at international level, innovation and patenting are actually considered important factors for competitive purposes in the sector (the KSFs) by the management of various departments in the company, not just the innovative ones.

A further and specific analysis of the advantages and disadvantages of patenting will allow us to highlight the criteria considered most important by managers for evaluating company patents.

In Chapter 6, we will describe the model developed resulting from the combination of the criteria highlighted in the literature and those emerging from the knowledge and perceptions of managers, we will apply it to company data and we will discuss the case study.

CHAPTER 4

The processes of generating innovations and patents.

The case study Benelli Armi S.p.A.

Introduction

Companies today find themselves operating in globalised and hyper-competitive contexts, in which the generation of innovations and the appropriation of the value they create, especially in technologically advanced sectors, becomes a prerogative for their survival and competitiveness.

The processes of generating innovations and patents are extremely complex processes, divided into numerous phases and, in light of this complexity, require careful and in-depth analysis; in fact, exploring how and why innovation is planned, developed and implemented is only part of the corporate innovative strategy that must be integrated with the way in which the results of innovative activities are managed.

In light of a lack of studies that investigate innovation strategies and patenting strategies together, at different company levels, this chapter aims to reconstruct these strategies, not limiting the analysis to the corporate and business levels, but also involving the most functional ones.

In this way, in order to frame strategic decisions at all levels regarding innovation and patents, we want to identify the subjects involved in the innovative and patenting processes and describe the activities carried out by them, the tools used to do so and the timescales necessary for the implementation of the various activities.

In particular, the chapter allows us to pursue the following objectives:

(i) investigate the way in which innovative strategies are planned, developed and implemented at different levels: corporate, business and functional, i.e. in terms of roles, activities, resources and timing.

(ii) investigate how patent strategies are planned, developed and implemented at different levels: corporate, business and functional, i.e. in terms of roles, activities, resources and timing.

This chapter is structured as follows:

(i) the first paragraph presents the topics of interest;

(ii) the second paragraph recalls the methodological techniques adopted for the realisation of the second part of the case study, the results of which are presented in the chapter: participant observation and personal interviews;

(iii) the third paragraph describes the company's innovative strategies, at corporate and business levels;

(iv) the fourth paragraph describes the company's innovative strategies, at a functional and operational level, illustrating the processes for generating innovations in the company;

(v) the fifth paragraph describes the company's patent strategies, at corporate and business levels;

(vi) the sixth paragraph describes the company's patent strategies, at a functional and operational level, illustrating the patent generation processes in the company.

Finally, a discussion of the results is provided.

1. A conceptual premise

In the current globalised and hyper-competitive competitive contexts, companies must be able to continuously generate innovations (developed by the companies themselves or by universities or research centres), especially in technologically advanced sectors, in order to ensure their survival and competitiveness (D'Aveni, 1995; D'Aveni *et al.*, 2010; Duran *et al.*, 2016; Marklund *et al.*, 2009; McNamara *et al.*, 2003).

At the same time, it is necessary to define a clear strategy that allows us to appropriate the value deriving from these innovations; in this sense, patents can be seen as a possible solution to the problem since they present numerous advantages compared to secrecy, mainly such as commercial exploitation from a semi-monopolistic situation and legal protection in the event of infringement.

The planning, development and implementation of innovative corporate activities should, therefore, take place not only with a view to generating technological innovations but also to appropriating the

value deriving from them, i.e. commercial exploitation from a semi-monopolistic situation, avoiding the efforts of the innovative process being wasted and competitors taking advantage of it.

The processes of generating innovations and patents are very complex, divided into numerous phases and, in light of such complexity, require careful and in-depth analysis; in fact, exploring how and why innovation is planned, developed and implemented is only part of the corporate strategy, which must also be integrated with the way in which innovative outputs are managed.

To the best of our knowledge, it is difficult to find studies that jointly investigate innovation strategies and patenting strategies at different company levels, that is, not limiting themselves to an analysis at corporate and business management levels, but also involving the more functional and operational ones.

For this reason, for the purposes of carrying out the Benelli Armi S.p.A. company case study, after having described the company strategy as a whole, it was decided to proceed with a framework of the innovative and patent strategies, at all company levels, i.e. showing the how they are planned, developed and implemented at a corporate, business and functional level.

In this way, we want to identify the subjects involved in the innovation and patenting processes and describe the activities they perform, the tools used to do so and the timescales necessary for the implementation of the various activities.

2. Benelli case part 2: a methodological premise

Below, the methodological techniques adopted for the realisation of the second part of the case study are recalled, the results of which, relating to the approach to innovation and patenting in Benelli Armi S.p.A., are presented in the chapter.

In particular, these results were achieved through the use of the two main methodological techniques used during the research doctorate, described in detail in the previous chapter: participant observation (Cardano, 2011; Corbetta, 1999) and in-depth interviews (Natale, 2007).

Participant observation can be defined as follows: “a research strategy in which the researcher inserts himself a) directly and b) for a relatively long period of time in a specific social group c) taken in his natural environment, d) by establishing a relationship of personal interaction with its members e) with the aim of describing their actions and understanding, through a process of identification, their motivations” (Corbetta, 1999).

The three-year experience as a participant observer has, in fact, allowed data and information to be collected over a long period of time, allowing us to understand social actions and interactions at a functional and operational level. However, it immediately emerged that simple observation could not be sufficient to fully understand the topics under study.

The reconstruction of the generation processes of the different types of corporate innovations (essentially product, process and organisational) and of the patent generation processes required, specifically, in-depth analyses made possible by conducting personal interviews with the President and Managers of the Technical Area, based on a semi-structured questionnaire.

In fact, alongside participant observation in the workplace, the method of gaining knowledge about research, which has always been more widespread and used in the world of social sciences, is questioning and consists of "an interview with one or more subjects, specifically selected, so that respond to a series of questions, previously set by the researcher, with the aim of knowing the interviewee's thoughts regarding those themes that the researcher has identified as the object of his research" (Natale, 2007).

In particular, in the chapter, paragraph 3 describes the innovative corporate strategies, defined at a corporate and business level, as a result of the analysis of section C of Questionnaire 1. Paragraph 4 illustrates the innovative corporate strategies at a functional and operational level, namely the processes of generating innovations, as a result of the analysis of section D of Questionnaire 1; it should be noted that, in the case of product innovations created by the Product Development Department, the analysis was cross-referenced with the data collected through participant observation. Paragraph 5 describes the company's patent strategies, defined at a corporate and business level, as a result of the analysis of section E of Questionnaire 1. Finally, paragraph 6 describes the company's patent strategies at a functional and operational level, i.e. the patent generation processes; it should be noted that, since only product innovations are patented, it was cross-referenced with the data collected through participant observation in the Product Development Department.

For the purpose of reconstructing the innovative and patenting processes, the subjects involved in these processes were identified and the activities they perform, the tools used to do so and the timescales necessary for the implementation of the various activities were described.

The detailed description of the single case study method and the investigation techniques used was presented in the previous chapter.

Below (Table 4.1) sections C, D, E and F of Questionnaire 1 are reported, indicating the respondents involved in the interviews. For the complete interview protocol, please refer to paragraph 3 of the previous chapter, while for the complete Questionnaire 1, please refer to the Appendix.

Table 4.1- Sections C, D, E and F Questionnaire 1 Strategy, Innovation and Patenting

Questionnaire sections	***Selected respondents***
SECTION C- INNOVATIVE CORPORATE STRATEGIES	President; Plant and Industrial Manager; Head of Sales.
SECTION D- CORPORATE INNOVATION GENERATION PROCESSES	Product Development Manager; Prototyping Manager; Treatment and Quality Assurance Manager; Industrialization Manager.
SECTION E- CORPORATE PATENT STRATEGIES	President; Plant and Industrial Manager; Product Development Manager; Prototyping Manager.
SECTION F- CORPORATE PATENT GENERATION PROCESSES	Product Development Manager.

Source: personal elaboration.

3. Innovative corporate strategies

As regards the approach to innovation at a corporate and business level, it was decided to address only the top management (President, Industrial and Plant Director and Commercial Director) as they were considered by the other respondents to the questionnaire to be "the only persons competent in the field of innovative corporate strategies at these levels".

The analysis revealed that the company has been operating for several years on all accessible world markets, i.e. those that can be reached as they are not limited by legislation and/or trade embargoes.

The innovative corporate strategy (Ansoff, 1987) is that of market penetration (same products; same markets) and product development (new products; same markets); the strategy has been this way for many years, or rather, the company continued to expand until it reached coverage of the current markets, i.e. all those that it is possible to serve and, in particular, this coincided with the development of Benelli USA in 1997.

As regards, however, the innovative company strategy at a business level (Porter, 1987), the one that is pursued in the various product families created, i.e. the businesses served (semi-automatic shotguns, over-and-under shotguns, pump shotguns, semi-automatic rifles, manual rifles and

compressed air guns), it emerged that a differentiation strategy is pursued both at a technological and an aesthetic level in each of them.

Generally speaking, the company aims to be a leader in the sector through continuous innovation and the strategies are not so interactive in terms of price and quality. This means that they are not greatly affected by the strategies of competitors and are not defined and modified in relation to the latter.

In general, the respondents believe that the company's innovative strategies are more advanced than those of its competitors. From this perspective, it can be stated that, according to managers and employees, Benelli is a true innovation leader in the sector.

4. Innovative processes

As regards the innovative strategy at a functional and operational level, i.e. the way in which the innovation generation processes are actually implemented, the following types of innovations (Schumpeter, 1950) carried out in the company have been identified, since they involve activities, resources, procedures and different subjects:

- product innovations, which can be defined as new technical solutions that can be implemented within a new product that can be sold on the market;
- process innovations relating to heat and surface treatments, which can be defined as new technical solutions that can be implemented within a new product that can be sold on the market;
- process innovations relating to the industrialisation of products and organisation, which can be defined as those processes that can be implemented in the context of industrialisation and, therefore, can be defined as innovations within the production process and, in a broad sense, organisational.

Product innovations

Product innovations can be defined as new technical solutions that can be implemented within a new product that can be sold on the market.

The lines of innovation for the development of new products are defined from below, i.e. by the Technical Area, sometimes listening to consumer needs and requests, but, in general, it is always the President who "decides where to continue". Therefore, these are innovations mainly driven by

technology, rather than by the market, in the context of which the President may or may decide to pass, playing a role in deciding whether or not to continue with project proposals, but sometimes also playing a role of visionary and stimulator of the continuous innovation as Benelli's strategy for excellence.

Therefore, decisions relating to the company's innovative strategy are taken at corporate and business level by the President and Managers, but the Technical Area enjoys a large amount of autonomy at the functional level, in terms of objectives to be achieved, activities, i.e. procedures to be carried out, resources and tools available and deadlines to be respected; the Technical Area often provides input on interesting innovative lines to follow.

In the development of product innovations, there are some criteria that must be respected: satisfying the specific needs of customers (example: a request for an adjustable nosepiece), satisfying customers' implicit needs (example: the Technical Area has developed the recoil reduction mechanism; no one had requested it but the consumer liked it) and seek uniqueness (example: for the 828U, the stock is separated from the carcass because Benelli arrived last in this product family and wanted to differentiate itself, and the search for differentiation occurred also with Lupo).

The Product Development Manager does not even notice a tight budget for innovation this limit, which must, however, be enfored by the Technical, Industrial and Plant Director.

At a functional level, specifically with regard to the generation of innovation, from when the initial idea is discussed, up to prototyping and market launch, the following has emerged in terms of roles, procedures, tools and timing.

As regards the roles, there are a total of 20 subjects involved in product innovation, belonging to the Product Development Department and the Experiences Department, which deals with prototyping; the two departments make up the Technical Area as a whole.

These are mostly people within the organisation (direct employees); however, the company uses an external professional, an architect, who is in charge of the independent development of design innovations.

The innovative idea regarding the product is developed internally, but sometimes "open innovation" processes are also used, which guarantee the exchange of knowledge with other companies but that also require the absorption of skills; this was the case of some innovative projects financed by public bodies such as the Marche Region.

As regards the innovative processes procedures carried out by internal subjects, they refer to the concept of “sharing”: using regular brainstorming sessions (i.e. meetings of the Technical Area employees), new ideas that differ from those of the competition are discussed, which emerge by analysing existing patents, benchmarking competitors’ weapons, supported by a Critical To Quality (CTQ) and analysing the difficulties encountered in the rifles produced.

The procedures adopted in the innovative processes that are carried out by external parties also refer to the concept of listening and “sharing”: through focus groups, made up of customers and/or resellers/importers to whom questionnaires are administered, an attempt is made to understand the needs of the customers, also through clear and explicit questions such as, for example, “What would you like in the new semi-automatic/over-under shotgun?”.

The architect designer is involved in the various steps of product development, as modifying the mechanics often involves a different design; consultants are more involved in the processes (additive manufacturing to develop/make done), each of which works on a specific working hypothesis to develop innovations for which specific internal skills are lacking.

As regards the resources available to the Technical Area departments, we highlight a competition analysis map developed jn brainstorming with the help of Quality Function Deployment (QFD), a tool also used by other companies, which is presented in the form of table, and allows a comparison/benchmark of the competition and a description of the objectives of the new projects. It is an Excel file, which consists of a pre-organised table containing various items (for example: Customer requests, Competition weights, Correlations and Results).

Another tool to support the implementation of innovative procedures is the flow chart, i.e. a list of steps/activities to be carried out in the company, which make up the procedure for developing new products (i.e. a check list of activities to be carried out).

Finally, as regards timing, it is necessary to distinguish between different projects: the development of the new product platforms from scratch takes approximately 3/4 years (for example for the development of the 828U over-under or the Bolt Action rifle), new product configurations or simply a restyling take from 6 months to 1 or 2 years of activity (example: new barrel calibre from 28 to 30, polymer stock) while for new engravings, approximately 1 year suffices.

If there are new processes, such as additive manufacturing, these stimulate creativity for new products, which were impossible to make until that moment like the BE Surface Treatment (BEST), that led to new rods with different components and /or different welds.

Furthermore, for product innovations only, which are particularly interesting for the present study, also because they are the only ones patented in the company, further aspects were investigated, with questions that arose at the time of the interview, with free answers and the following emerged.

Product innovations are also linked to design innovations, so much so that these two types of innovations take place in parallel (example: if the architect creates new lines, part of the mechanics must be modified and vice versa).

The average life cycle of the products is approximately 10 years; after 10 years, an improvement is introduced (for example, this was the case of the new finishes in the Raffaello 2013 compared to that of 2003 and it is the case of the new progressive comfort in the Raffaello 2023 compared to the one from 10 years ago). If they are military rifles, the need for renewal is slower.

Once a product is replaced by another, it is phased out. Due to customer requests, the warehouse is used, the equipment is dismantled but the spare parts are retained (example: the 12-gauge Raffaello of 2013 replaced the 2003 Raffaello 12 gauge and this is being phased out).

Process innovations (heat and surface treatments)

Process innovations concern the development of new technical solutions that can be implemented for a product that can be sold on the market and, in the company, concern new heat and surface treatments.

Unlike product innovations, innovation lines are defined from above since the input is strategic (by the President) or even at the same level (by the Commercial Area); the Treatment Area Manager takes inspiration from expired patents to develop new procedures for the company and interfaces with external suppliers to create new cycles, but the strategic decision is for these innovations not to be patented.

Therefore, decisions relating to the innovative corporate strategy are taken at Corporate level by the President (as was the case with chemical nickel plating or treatment) and by the Managers and, at a later stage, it is developed at a business and functional level with regards to the development of new treatments, in terms of objectives to be achieved, activities (i.e. procedures/modalities) to be carried

out, resources and tools available and timescales to be respected, which “often provides input” on the interesting innovative lines to follow.

In the development of process innovations of this type, there are some criteria that must be respected: satisfying the specific requests and needs of the corporate levels that started the project.

The Manager has a budget, but not personally: once a year, the Technical, Industrial and Plant Director asks the various Managers to indicate which investments are to be made for the next 1/2 years (cost estimate, after budgetary offers to be suppliers of various materials).

At a functional level, specifically with regard to the generation of innovation, from the moment the initial idea is discussed, to validation of the process, in terms of roles, procedures, tools and timing, the following has emerged.

As regards the roles, there are a total of 5 subjects involved in process innovation, who belong to the Thermal and Surface Treatments Department (Treatment Area Manager, 3 people in the chemical/metallographic laboratory and a department head, part-time) and 11 in the BEST Department (1 head materials engineer and 10 workers).

Once the process is qualified in the laboratory, it goes to the Experience department to validate it and, once validated, to the Industrialisation department.

Unlike product innovations, there are not just people within the organisation (direct employees) as it is necessary to collaborate with other companies for process innovations (in particular, the BEST treatment).

External suppliers are therefore also involved for technologies that the company does not possess but at the same time there is no great need for external consultants. Open innovation (projects with another company, including through conferences and seminars) has also been tried, but with limited success.

As regards the procedures in the innovative processes carried out by internal subjects, they essentially refer to the development of processes and laboratory activities.

The procedures in innovative processes carried out by external parties are also essential, i.e. the activities of suppliers are used to carry out tests and validate the processes.

As regards the resources available to the Heat and Surface Treatment departments, many types of software are used.

Finally, as regards timing, it is necessary to distinguish between different projects, as in the case of product innovations, but unlike the latter it is difficult to define clear timing as it depends on the results of the tests and the fine-tuning of the systems: some projects (such as chemical nickel plating) required 2/3 years because they must be qualified as feasible and a decision had to be made whether or not to buy the plant while other processes needed 5/6 years to implement the project in the company and buy the machinery to share the risks with the supplier and the setup (such as the BEST treatment, which had to deal with long stop periods).

Process and organisational innovations (production supervision via software, production planning and organisation)

Process innovations concern those processes that can be implemented in the field of industrialisation and, therefore, can be defined as innovations in the production process and, in a broad sense, organisational, such as, for example, the supervision of production through software, planning and the organisation of production.

The lines of innovation are defined from below; in general, it is the Manager who decides the lines of innovation but the flow is not well defined. The input can be strategic (President and Managers) since the company does not focus only on the hardware part (robot) or on the rigidity of the tasks but, especially in recent years, the company has tried to modify the way of planning and producing. Consequently, organisation has also changed.

The input can also come from a production department manager, from competitors, from suppliers or even from below, i.e. from the Technical Area in relation to product needs. It should be remembered that “producing 300.000 rifles a year is the result of a flexible organisation”.

Therefore, decisions relating to the company’s innovative strategy are taken at corporate level by the President and Managers, however the Industrialisation Area has a large amount of autonomy at business and functional level, in terms of objectives to be achieved, activities, i.e. procedures to be carried out, resources and tools available and deadlines to be respected. The Technical Area “often provides input” on interesting innovative lines to follow.

The Industrialisation Office makes investment proposals but decisions are always made at management level. After a decision has been reached at Industrial Management level, the Plant Director interfaces with the President.

In the development of process/organisational innovations, there are some criteria that must be respected: trying to have clear and available information, updated day by day, on the basis of which decisions can be made; optimisation of the production process, since the various department managers identify a specific need and decide whether to invest or not (example: robots have allowed significant time savings in the transfer of goods from department to department) and optimise the industrialisation of new products.

As regards compliance with the budget, the return on investment of the projects is calculated and there is an annual investment budget to be respected, which the Industrial Management confirms after having consulted the individual Areas. To decide whether to include an innovation, other priorities must be checked.

At a functional level, as regards specifically the generation of innovation, from when the initial idea is discussed up to the validation of a process within the production organisation, in terms of roles, procedures, tools and timing, the following has emerged.

As regards the roles, there are a total of 10 individuals involved in product innovation, belonging to the Industrialisation Office and one in the Machine Room and there is fundamental support from the innovation departments as internal subjects; furthermore, an external consultant, the skills of suppliers and design studios in new equipment/calibres/tools are consulted as external people. There is, therefore, open innovation.

Consultants are more involved in the processes, each of which works on a specific working hypothesis to develop innovations for which specific internal skills are absent.

As regards the procedures in innovative processes, these are carried out by internal subjects, as in product innovations, they refer to the concept of listening and “sharing”; these are the activities carried out in the department, where the industrialisation of products is dealt with on a daily basis, including new ones, but where, on an innovative level, especially in recent years, an attempt has been made to change the way of planning and producing and, as a result, the organisation has also changed.

As regards the procedures carried out by external parties, as mentioned, numerous external consultancies and design activities are used and Open Innovation is therefore considered to exist; indeed, there is cooperation with universities and consultancy companies.

As regards resources, they concern the data available in the company to carry out analysis relating to quantities, design software and machinery.

Finally, regarding timing, on average, it takes 2 years to develop new procedures.

To complete the investigation conducted, and again distinguishing between product innovations, process innovations relating to heat and surface treatments and process innovations relating to the industrialisation of products and organisation, we wanted to investigate the main sources of innovation and the links between the different types of innovations developed.

As regards the sources of innovations, we wanted to distinguish between sources inside and outside the company in the context of learning by doing, learning by using and learning by searching (Comacchio, 1996; Bettiol and Di Maria, 2014) on a scale of 1 to 5 for each individual activity.

In the context of learning by doing, process improvement, employee involvement and activation are recognised as very important (internal sources) for all types of innovations developed; this also happens with interaction with suppliers but on the contrary, neither imitation nor cooperation with competitors (external sources) is relied on for any of the types of innovations considered.

Furthermore, regarding learning by using, hardware and software improvement (internal sources) is important for product and process/organisational innovations but not so much so for processes/treatments, while interaction with customer-users (external sources) is very important for all types of innovations considered.

Finally, as regards learning by searching, the finalised search for new ideas, design and marketing is important for products and processes/treatments, less so for organisational processes, while cooperation with research institutes is interesting for products and organisational processes but is not very successful for processes/treatments (internal sources); innovation intermediaries (external sources) are not very important for all the types of innovations considered.

As regards the link between the various types of innovation, it emerged that product innovations are linked to process innovations, although it is not clear whether the product anticipates the process or vice versa.

According to the Product Development Manager, if there are new products that require new processes, it is the product innovation that “pulls” the process innovation (example: MIM, new products required a new method for printing).

The Treatment and Quality Assurance Manager maintains that, generally speaking, the process precedes the product, as in the case of the BEST treatment (process innovation) with the Raffaello Be-Diamond (product innovation) and chemical nickel plating. The Industrialisation Manager claims that, it is the product that anticipates the process, i.e. the input comes from the Technical Area, but at project level it should know the process, in order to obtain greater synergy.

5. Corporate patent strategies

As regards the approach to patenting at a corporate and business level, it was decided to turn to the top management, the President and Industrial and Plant Director, but also to the Product Development Manager, as the more operational departments also participate in defining the patent strategy.

The analysis revealed that the company's patent strategy at a corporate and business level is both aggressive and defensive; this means that, in the first case, you want to obtain a market share or consolidate the existing one through the new patented products present in the portfolio while in the second case, you want to maintain the position acquired, continuing to market the old products patented in the portfolio. All respondents believe that this patent strategy has not changed over time.

Following specific management provisions, "only product and design innovations are patented, as they are more easily imitated by competitors than process innovations".

It immediately emerged that it is not possible to divide the analysis regarding the patent strategy between the different company levels, as in the case of the innovative strategy because, as mentioned, the most operational departments also participate in defining patent strategy. For this reason, we focused mainly on the patent generation processes and the following is the result of the data and information collected in the Product Development Department during the period spent in the company and the interviews conducted.

6. Patenting processes

As regards the specific lines of innovation protection, input comes first of all from the Technical Area; unlike the innovation generation lines, where the President is also involved, the one relating to the innovation protection lines is a more operational decision; it is difficult for the President to exclude some countries. So, it is a decision that starts from the Technical Area.

The decision on whether or not to start the patenting procedure lies with the Manager of the Product Development Department, the Technical, Industrial and Plant Director and, if the innovation is very important and the patents very expensive, also with the President.

There are no particular criteria to start the patenting procedure; product and design innovations are patented, which have a minimum innovative content without following criteria, even budgetary ones, or strategic considerations.

At a functional level, specifically regarding the generation of patents, from the moment the decision to patent is made until the patent is obtained, the following has emerged in terms of roles, procedures, tools and timing.

As regards the roles, there are a total of 6 internal subjects involved in the product innovation protection processes (the President, the Technical, Industrial and Plant Director, the Manager of the Product Development Department, 2 people from the Product Development Department and 1 from the General Administrative Office); an external party (the Zini Patent Office of Pesaro) is also involved.

As regards the procedures in the patenting processes the following activities are carried out by internal subjects: 2 of them (from the Product Development Department) study the existing patents and draft the new patent; 1 (The Product Development Department Manager) supervises this activity; 1 subject (the Technical, Industrial and Plant Director) carries out the procedures and presents them to the President and also deals with the management of Intellectual Property working with consultants; 1 (the President) signs the paperwork as the owner of the company; 1 (General Administrative Office) deals with the bureaucratic part (payments requested by the Zini Patent Office) once the activities of the previous subjects have been concluded.

The Zini Patent Office carries out research on existing patents; deals with the part relating to the patentability of the innovation for which a patent is desired: it says whether an innovation is patentable or not, at an Italian and international level and writes the patent in the right language.

Regarding the resources/tools with which these activities are implemented, statistical processing programmes are used internally to search existing patents.

The average timeframe for obtaining patent coverage is approximately 18 months-2 years (for example for Italy it is around one year while for the European Union it is around three years).

In particular, it is possible to state that “the company aims to patent only product and design innovations, without strategic considerations relating to the value of the patents”.

In line with company management provisions, the Product Development Manager and the Prototyping Manager also believe that secrecy is to be preferred in processes and not in products, as product innovations are more easily imitated “when competitors have the new product in their hands”, which they can imitate.

Below a summary of two stories of patents of the company is proposed.

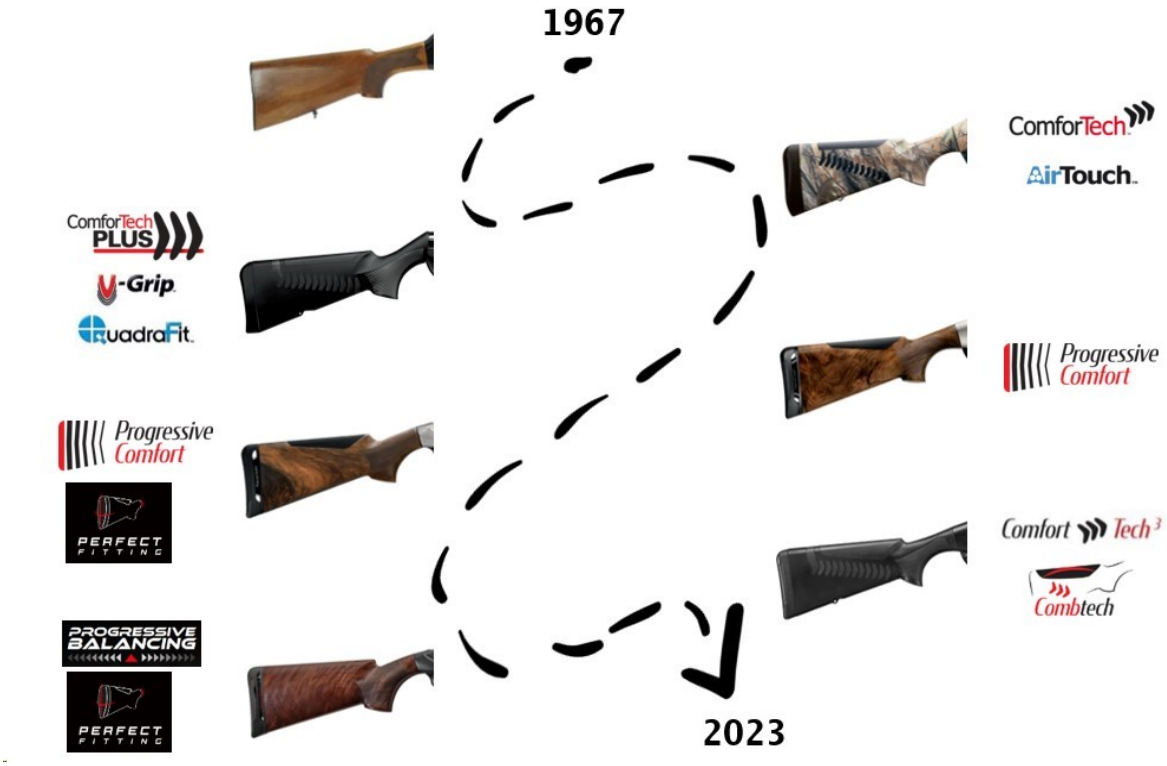
Case history 1

The patent “Comfort” protects the balancing device for firearms and identify a lot of the products of the company.

The solution developed is the result of a continuous research and the subjects involved are the President and the Managers of both the Technical Area and the Commercial Area.

Overtime, these activities have led to five different corporate families of patents (Figure 4.1).

Figure 4.1- Comfort technology



Source: company material.

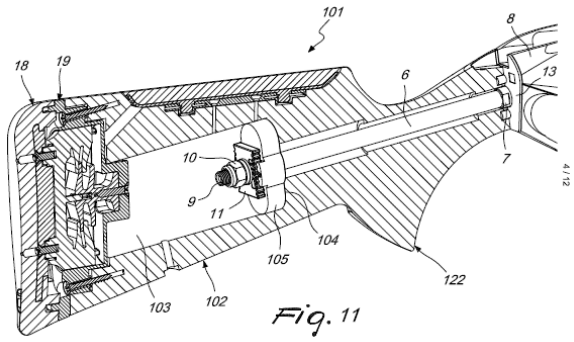
Case history 2

The patent “Gun stock” protects a specific innovation applied to few products of the company.

The solution developed is the result of a identify and the subjects involved are the Managers of the Technical Area but not the ones of the Commercial Area and the President.

Actually, these activities have led to a family of corporate (Figure 4.2).

Figure 4.2- Gun stock technology



Source: company material.

Below a summary of the company's innovation processes and the development of the patent portfolio is proposed (Figure 4.3).

Figure 4.3- Summary of the company's innovation processes and the development of the patent portfolio

Source: company material.

Conclusions

This chapter aimed to present the results of the analysis conducted in order to investigate the innovative and patenting strategies in a company that declares itself an innovation leader, also at an international level.

Innovative and patent strategies are defined and implemented at different company, corporate, business and functional levels.

It emerged that innovative strategies are highly structured as they always involve top management in deciding which projects to continue with, although this often occurs under the stimulus of the Technical Area and sometimes also of the Commercial Area.

At an operational level, there is a clear division of tasks between the subjects involved in the innovation and patenting processes.

The company pursues objectives of continuous innovation and patenting and this occurs on the basis of the stimulus and strategic vision of the leader, who carries out his role as President, inspiring collaborators to drive change.

On the contrary, patenting strategies are more operational and the specific responsibility of the technical departments, although the President also dictates the guideline in this case, as only product and design innovations are patented, being more easily imitable by the competition compared to innovations of process.

At an operational level, there is a clear division of tasks between the subjects involved in the patenting processes. Different procedures are thus implemented, often with specific technical content, and are supported by innovative tools and programmes and with different timing.

It is therefore possible to say that innovative strategies and patenting are partly top down and partly bottom up.

After describing the company strategy, in terms of vision, mission and company values, with particular reference to innovative and patent strategies, Chapter 5 will contain the results of the survey conducted to investigate the main KSFs of the sector will be described, to understand whether innovation and patents are actually perceived as important factors by management for competitive purposes.

CHAPTER 5

Innovation and patenting as competitive purposes in the arms sector. The case study Benelli Armi S.p.A.

Introduction

The objective of this chapter is to answer Research Question 3 (RQ3), reported in the Introduction to the doctoral thesis and referred to below:

- ✓ *RQ3- What role do innovation and patenting play for competitive purposes in the arms sector?*

To answer this question, we proceeded through a series of interviews with the President and company managers, in order to bring out their perception on the importance of innovation and patents in the hunting and sporting weapons sector, trying to highlight whether and to what extent these factors are considered critical factors for competitive success.

In this regard, the main KSFs guaranteeing success to companies operating in technologically advanced sectors in the current globalised and hyper-competitive contexts have been identified.

Furthermore, the chapter investigates the knowledge and perceptions of management inherent to the strategy and management of patents in order to identify the criteria considered most important for their evaluation, necessary for the development of a specific decision-making model for the evaluation and categorisation of company patents.

In particular, the chapter allows us to pursue the following objectives:

(i) highlight the role played by innovation and patenting for competitive purposes in the arms sector;

(ii) investigate the criteria considered most important for the evaluation of company patents, necessary for the development of a specific decision-making model.

This chapter is structured as follows:

(i) the first paragraph presents the topics of interest;

(ii) the second paragraph recalls the methodological technique adopted for the realisation of the third part of the case study, the results of which are presented in the chapter: personal interviews;

(iii) the third paragraph investigates the management's perceptions of the main success factors of the arms sector, in particular of the hunting and sporting rifles business, with the aim of highlighting the importance of innovation and patenting processes for competitive purposes, as acknowledged by the managers;

(iv) the fourth paragraph enriches the analysis conducted, investigating the management's knowledge and perceptions on the various aspects of innovation and patenting, both at sectoral and company level, such as the main drivers for innovation, technology or consumers, the main types of innovations, either radical or incremental, and the main advantages and disadvantages of patenting;

(v) the fifth paragraph proposes an interpretation of what emerged from the investigation, in order to identify the criteria considered to be most important for the qualitative evaluation of patents;

(vi) the sixth paragraph attributes an order of importance to the identified criteria, which is fundamental for the development of the decision-making model to support management for the purposes of patent renewal decisions.

Finally, a discussion of the results is proposed.

1. Key Success Factors in technologically advanced sectors

In order to obtain the competitive advantages of differentiation, companies must be able to excel in the KSFs of their sector.

In general, the main KSFs are, generally speaking, information and communication, product, product cost, product delivery and production (Sousa and Hambrick, 1989) but more recently, especially in technologically advanced sectors, additional factors have been identified as important for competitive success, such as brand (Kotler *et al.*, 2021), design and innovation (Verganti, 2008).

Nowadays, therefore, in technologically advanced sectors, the factors capable of guaranteeing a lasting competitive advantage for the companies that operate therein and on which they base their value offering are strongly linked to innovation (Ferrucci, 2020).

Companies must be able to continuously generate innovations (developed by the companies themselves or by universities or research centres), i.e. innovative and qualitatively good products, for the purpose of their survival and competitiveness (D'Aveni, 1995; D'Aveni *et al.*, 2010; Duran *et al.*, 2016; Marklund *et al.*, 2009; McNamara *et al.*, 2003) but they must also be able to appropriate the value they generate.

In fact, the ability to generate new knowledge (through internal investments in R&D), to absorb it (integrating external knowledge) and to appropriate the value thus generated (for example, through the formal protection of intellectual property) are determinants of growth in the different innovation patterns (Piccaluga *et al.*, 2019).

In this sense, patents can be seen as a possible solution to the problem since they present numerous advantages compared to secrecy, such as commercial exploitation from a semi-monopolistic situation and legal protection in the event of infringement (see, among others, Cohen *et al.*, 2000, Rivette and Kline, 2004), playing an important strategic role for the appropriation of value from corporate innovations.

The importance of innovation and patenting for competitive purposes varies from sector to sector and in this regard, we wanted to investigate the perceptions of the Benelli Armi S.p.A. management regarding the role played by these two factors for competitive purposes.

2. Benelli case part 3: a methodological premise

Below, the methodological technique adopted for the realisation of the third part of the case study is recalled, the results of which, relating to the importance attributed to innovation and patents in the arms sector and to the criteria considered most important for the evaluation of the latter in Benelli Armi S.p.A., are presented in the chapter.

In particular, these results were achieved through the use of the in-depth interview technique (Natale, 2007).

The three-year period, in fact, allowed data and information to be collected over a long period of time, allowing us to understand social actions and interactions at a functional and operational level. However, it immediately emerged that simple observation was not sufficient to fully understand the topics under study.

In fact, alongside participant observation in the workplace, the method of gaining research knowledge, which has always been more widespread and used in the world of social sciences, is questioning and consists of "an interview with one or more subjects, specifically selected, so that they respond to a series of questions, previously set by the researcher, with the aim of knowing the interviewee's thoughts regarding those themes that the researcher has identified as the object of his research" (Natale, 2007).

The investigation of the company management's perception of the importance of innovation and patents in the arms sector specifically required in-depth analyses made possible by conducting personal interviews with the President and Managers of both the Technical Area and the Commercial Area, using a semi-structured questionnaire.

In particular, in Chapter, paragraph 3 investigates the importance of innovation and patenting in the arms sector recognised by the interviewees, as a result of the analysis of section A of Questionnaire 2. Paragraph 4 enriches the analysis conducted through an overview of innovation and patenting, in terms of innovation drivers (technology or consumers), types of innovations achieved (radical or incremental) and main advantages and disadvantages deriving from patenting in the arms sector, as a result of the analysis of section B of Questionnaire 2. Paragraph 5 proposes an interpretation of the interviews, identifying the criteria considered most important for evaluating patents. Finally, paragraph 6, according to the responses of the interviewees, attributes an order of importance to these criteria, which will constitute the basis for the development of the patent qualitative evaluation model.

The detailed description of the single case study method and the investigation techniques used was presented in Chapter 3.

Sections A and B of Questionnaire 2 are reported below (Table 5.1), indicating the respondents involved in the interviews. For the complete interview protocol, please refer to paragraph 3 of Chapter 3, while for the complete Questionnaire 2, please refer to the Appendix.

Table 5.1- Sections A and B Questionnaire 2 Key Success Factors and Patent Evaluation

Questionnaire sections	*Selected respondents*
SECTION A- PRESENTATION OF THE INDUSTRY: KEY SUCCESS FACTORS AND POSITIONING OF THE COMPANY	President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.
SECTION B- DRIVERS OF INNOVATION, TYPES OF INNOVATIONS AND ADVANTAGES AND DISADVANTAGES FROM PATENTING IN THE INDUSTRY AND IN THE COMPANY	President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

Source: personal elaboration.

3. Innovation and patenting for competitive purposes in the arms sector

This analysis began by trying to identify the main KSFs of the arms sector, i.e. those factors capable of guaranteeing lasting competitive success for the companies that operate therein, highlighting whether and to what extent the processes of innovation and patenting are considered relevant for competitive success by the President and company Managers.

In particular, we expected to understand, from the interviewees' opinions, how much innovation and patenting represent important requirements for competitiveness in the sector to which they belong, not limiting the investigation to the technical departments, already involved in the analyses presented in Chapter 4, but extending it to commercial ones.

It was believed, in fact, that this investigation was particularly interesting if carried out in the two main areas of every manufacturing company: the Technical Area, which in the development and prototyping of new products and processes also interfaces with the actual "Factory" itself and the Commercial Area, which maintains relationships with Italian agents and foreign importers and takes care of marketing operations with them and with end consumers during trade fairs.

By adopting these two points of view, that of the Technical Area and that of the Commercial Area, a competitive scenario of the sector was obtained, which was subsequently integrated with the one provided by the President who, with his over forty years of experience, provided a complete interpretative framework of both.

The two areas are closely connected to each other, although it is commonly thought that they are two separate worlds; in fact, the Technical Area sees innovations for their intrinsic content (technological and legal aspects) while the Commercial Area considers them for the possibility that the innovative

products can be successful on the market (economic and market aspects); by definition of the Industrial Property Code (IPC), in fact, an innovation is an invention actually capable of being applied to a product that can be sold on the market.

In order to investigate the importance of innovation and patenting for competitive purposes in the arms sector, six KSFs in the various sectors of the economy were chosen, i.e. including "classic" factors such as price and quality, but also factors "specific" to technologically advanced sectors such as brand, design, innovation and intellectual property.

In fact, especially in technologically advanced sectors, the appropriation of the value generated by technological innovations is today made more difficult by the fact that their rapid development and diffusion has increased the threats of imitation by global and multinational competitors, giving rise to a greater need for protection of innovations; this need can be satisfied by specific titles, such as IPRs, which include patents (along with trademarks, copyrights and industrial secrets) and which therefore can play an important role in the company's survival and competitiveness .

Each respondent was, therefore, asked to attribute a score in percentage terms to each of the selected KSFs, and in such a way that the sum was equal to 100, in order to allow a comparison of the importance of each factor compared to the others, for competitive purposes; this evaluation scale was agreed with management.

The summary table of the results is presented below (Table 5.2).

Table 5.2- Values attributed to the Key Success Factors (KSFs) of the arms sector by the President and average values of the scores attributed by the individual respondents belonging to the Technical Area, by the individual respondents belonging to the Commercial Area and overall, from all respondents

Key Success Factors	President	Managers Technical Area	Managers Commercial Area	All respondents
Brand	30,00	23,33	30,00	27,50
Design	10,00	20,00	21,25	19,38
Innovation	5,00	21,67	9,50	13,50
Intellectual Property	30,00	8,33	5,50	9,63
Price	5,00	8,33	12,50	10,00
Quality	20,00	18,33	21,25	20,00

Source: personal elaboration.

In general, brand, design and quality are recognised as the main KSFs of the firearms sector, although as in all qualitative analyses of this type, it is also necessary to consider what has been said "beyond the numbers".

In fact, all the interviewees believe that innovation is an element of vital importance for competitiveness in the arms sector and closely connected to quality since, as the President himself stated, "after the engineers have worked on something qualitatively valid and appreciated by the market, only later do they realise that they have developed something innovative and patentable".

Therefore, the average score attributed to innovation, lower than that of other KSFs, is due to the fact that the importance of innovation for competitive purposes is indirectly recognised by the interviewees, through the attribution of high scores to the quality of the product.

Furthermore, innovation is closely connected to intellectual property, which is considered already included in it; therefore, in this case too, the low scores that have been attributed to intellectual property for competitive purposes do not indicate a lack of importance recognised for patents in the sector but rather to the fact that customers purchase a product because it is new and innovative, not because it is patented, although, as will emerge later, patents increase the image and reputation of the company in their eyes and in those of their competitors.

Finally, the price, according to seven out of eight respondents, is not considered decisive for success in the sector since it is not an element to which Benelli customers pay particular attention, as they are willing to pay a higher price than that of the competition, in the face of quality that is undoubtedly higher than that of the competition.

Also in this case, it should be underlined that this opinion of the managers is consistent with the fact that the company's competitive strategy (Porter, 1987) is based on differentiation, on the uniqueness of the offering of innovative, well-made, aesthetically pleasing and ergonomically functional products, rather than on cost leadership.

The KSFs investigated are those that should guarantee success in the arms sector, but the respondents, who have gained all their experience in the sector within the company (apart from one respondent), are inevitably influenced by the importance of the factors that guarantee success to that company, which does not focus much on low price ranges.

Therefore, price remains a fundamental KSF in all sectors, including the arms sector, but it is not a factor on which Benelli bases competition.

The survey conducted made it possible to highlight the importance attributed to each KSF chosen by the company's management, highlighting an importance, even if not clearly expressed with high scores in percentage terms, recognised for innovation and patenting.

It was decided to continue by trying to specifically investigate the importance attributed to innovation and patents as KSFs, in absolute terms, from 1 to 5.

Each respondent was therefore asked to assign a score in absolute terms to innovation and patents, in order to investigate the management's perceptions regarding the importance of the two KSFs for competitive purposes in the arms sector.

The summary table of the results relating to innovation and patents (Table 5.3) is presented below.

Table 5.3- Values attributed to innovation and patents as a Key Success Factor (KSFs) of the arms sector by the President and average values of the scores attributed by individual respondents belonging to the Technical Area, by individual respondents belonging to the Commercial Area and overall, by all respondents

Key Success Factors	President	Managers Technical Area	Managers Commercial Area	All respondents
Innovation	4,00	5,00	4,00	4,38
Patents	4,00	4,33	3,25	3,75

Source: personal elaboration.

In absolute terms, all respondents generally believe that innovation is very important for competing in the weapons sector, while they believe that patents are quite important for competing in the weapons sector.

In fact, in addition to the analysis of the KSFs in percentage terms, the survey conducted made it possible to highlight the actual importance attributed by the company's management, in absolute terms, to innovation and patenting, confirming, as highlighted, their importance previously embedded in other factors.

It is possible, therefore, to state that the importance given to innovation and patents is high for competitive purposes and Benelli bases its competitiveness on these factors.

The President and also all the respondents belonging to the Technical Area and the Commercial Area also believe that Benelli aims to be a leader in the sector through continuous innovation and that it is effectively a leader in technologies, that it develops them first and that, therefore, it is more innovative than its main competitors in all product families, holding leadership from this point of view.

Furthermore, they believe that Benelli is also a leader in patenting processes; although the development of innovations, and consequently patents, are the exclusive responsibility of the Technical Area. The Commercial Area also believes that Benelli has a high number of patents compared to its main competitors, also in this case being leaders from this point of view; this perception is linked to the fact that there are constantly new products in the portfolio, although it must be remembered that the latter may also contain a non-patented improvement.

The following figure presents a summary of the main KSFs of the company (Figure 5.1).

Figure 5.1- Key Success Factors (KSFs) of the company

Source: company material.

4. Innovation and patenting in the arms sector and in the company

In order to enrich the analysis conducted and present a more complete overview of innovation and patenting, we wanted to investigate further aspects, such as the drives for innovation (technology or consumers), the types of innovations achieved (radical or incremental) and the main advantages and disadvantages deriving from patenting in the weapons sector.

In particular, the survey was carried out both in percentage terms, from 1 to 100, in order to allow a comparison of the elements analysed, and in absolute terms, from 1 to 5 in order to analyse each individual aspect considered.

As regards innovation in the arms sector, we wanted to understand whether it was driven more by technology or by consumers (Table 5.4) and to what extent and if innovations in the arms sector can be defined as more radical or incremental and to what extent (Table 5.5).

Table 5.4- Drives of innovations

Drivers of innovations	President	Managers Technical Area	Managers Commercial Area	All respondents
Technology push	100,00	56,67	85,00	76,25
Demand pull	0,00	43,33	15,00	23,75

Source: personal elaboration.

All respondents believe that innovation in the sector is driven mostly (on average 80%) by technology and only to a lesser extent (on average 20%) by consumers.

The fact that the input to innovation is internal to the sector and the technical departments of the companies, rather than coming from market desires, is clearly expressed by the President but also by the Commercial Area, but the gap between the two sources is not considered so evident and marked in the Technical Area, which also takes inspiration from market ideas.

Table 5.5- Types of innovations based on degree of novelty

Types of innovations based on degree of novelty	President	Managers Technical Area	Managers Commercial Area	All respondents
Incremental innovations	100,00	83,33	86,25	86,88
Radical innovations	0,00	16,67	13,75	13,13

Source: personal elaboration.

Furthermore, all respondents believe that innovation is more incremental (85% on average) than radical (15% on average), as could reasonably be expected, given the difficulty in developing something "absolutely" new.

The difference between the two types of innovations is clearly expressed both by the President and by the Technical and Commercial Areas.

As regards patenting, we wanted to investigate the main advantages (Table 5.6) and disadvantages (Table 5.7) of patents in the weapons sector (from 1 to 100, total set at 100), with the ultimate aim of investigating and interpreting the management's knowledge and perceptions on the topic of patents and identifying those criteria considered most important for their evaluation in the company.

Table 5.6- Advantages of patenting in the arms sector

Advantages of patenting in the sector	President	Managers Technical Area	Managers Commercial Area	All respondents
Protection from imitation	70,00	33,33	35,00	38,75
Limitation from connected innovations	10,00	16,67	16,25	15,63
Increasing of revenues	10,00	23,33	21,25	20,63
Improvement of image and reputation	10,00	26,67	27,50	25,00

Source: personal elaboration.

Table 5.7- Disadvantages of patenting in the arms sector

Disadvantages of patenting in the sector	President	Managers Technical Area	Managers Commercial Area	All respondents
Difficult to demonstrate innovation novelty	0,00	16,67	30,00	20,00
Disclosure of information	0,00	33,33	28,75	26,88
Procedural and maintenance costs	60,00	30,00	18,75	28,13
Possible court costs to protect against infringement	40,00	20,00	23,75	24,38

Source: personal elaboration.

The survey revealed that on average all respondents believe that the main advantage guaranteed by patents is that of limiting imitation, since it is never completely averted, while the main disadvantage is the high patenting costs; this emerged both in percentage and absolute terms.

In order to identify the criteria considered most important for patent evaluation, the main advantages (Table 5.8) and disadvantages (Table 5.9) deriving from the company patents (from 1 to 5, for each advantage/disadvantage), previously investigated, have been broken down into specific advantages and disadvantages deriving from patenting, on a scale from 1 to 5 for every single aspect in the company.

Table 5.8- Advantages of patented company products

Advantages of patents in the company	President	Managers Technical Area	Managers Commercial Area	All respondents
Protection from imitation	4,00	4,00	4,00	4,00
Limitation from connected innovations	2,00	2,50	2,00	2,14
Increasing of revenues	2,00	2,67	1,75	2,13
Improvment of image and reputation	4,00	4,00	3,67	3,86

Source: personal elaboration.

Table 5.9- Disadvantages of patented company products

Disadvantages of patents in the company	President	Managers Technical Area	Managers Commercial Area	All respondents
Difficult to demonstrate innovation novelty	1,00	2,33	2,00	2,00
Disclosure of information	1,00	4,00	4,25	3,75
Procedural and maintenance costs	4,00	3,33	3,33	3,43
Possible court costs to protect against infringement	3,00	3,67	3,50	3,50

Source: personal elaboration.

In relation to the advantages, respondents believe that patents partly discourage imitation; in fact, patented company products are still widely imitated, but despite this it is important to patent in order to keep the product new on the market and exploit it commercially; the limitation of imitation remains one of the main advantages of patenting together with the increase in the company's reputation and image in the eyes of consumers and competitors.

The development of blocking related patents, i.e. those patents developed because they are capable of blocking competitors' patents and specific cash flows attributable to the patent, are considered less important; although the new products, whether patented or not, in the portfolio, guarantee an excellent level of turnover (equal to approximately 20% of the total in Italy and 30% in foreign markets). It is in fact difficult to argue that a new patented product guarantees greater cash flows than a new unpatented one, since a customer buys a gun not because it is patented (which covers the innovation contained in it) but due to other elements such as quality, design or brand.

In relation to the disadvantages, the respondents believe that the patent involves the disclosure of a lot of information and also entails a high amount of procedural and maintenance costs, but also those involved in a possible lawsuit in Court; however, it must be considered that procedural and maintenance costs are high in various areas of the world as there is probably a lot of speculation and the costs of court cases are high as all cases are high and, therefore, this cannot be attributed to patents. It is believed, however, that there is little difficulty in demonstrating the novelty of an innovation.

5. Managerial theoretical considerations and implications

In addition to understanding the acknowledged importance of innovation and patenting for competitive purposes in the sector, the analysis presented during the chapter had the objective of investigating and interpreting the management's knowledge and perceptions of patent strategies and management and thus identify the criteria considered most important by the respondents for the purposes of evaluating company patents.

The interviews conducted collected data and information and from these considerations were drawn regarding strategies, management and advantages and disadvantages of patents, in order to identify the criteria to be included in the evaluation model for the company.

First of all, with their experience in the sector consolidated over time (in almost all cases, at least over twenty years), and in line with the prevailing literature on the subject of qualitative evaluation of patents, the respondents believe that "the aspects to be considered in such evaluations must belong to different dimensions since the patent protects an innovation applied to a product sold on the market".

Since the model that we intend to propose deals with ex post evaluations, i.e. after the patent has been obtained and not ex ante, the technological and legal dimensions are not considered to be particularly important for this work by the respondents since the novelty of the technology and the fact that it is not in conflict with other patented products is demonstrated by the fact that the patent has already been obtained.

In particular, the interviews conducted made it possible to investigate managers' perceptions of the advantages and disadvantages deriving from patenting, which were interpreted thanks to the feedback and additional information provided by the interviewees.

All those interviewed believe that it is "difficult to separate the evaluation of the innovation from the evaluation of the patent title that protects it"; therefore, we cannot only talk about "the evaluation of a patent" but, in a broad sense, "the evaluation of the patented innovation, contained in a product that has a positive/negative response on the market".

Therefore, the patent takes on not only a technological dimension but also an economic and marketing one and, broadly speaking, also a strategic one.

The data collected during the personal interviews, cross-referenced with the information collected on patents in the Product Development Department as a participant observer, were analysed and codified into "significant" statements; it was thus possible to identify six criteria particularly important for the qualitative evaluation of each patent:

- the compliance of the patented product with the KSFs of the arms sector, since the respondents believe that “an innovative product is successful on the market if it incorporates the factors important for competitive purposes”;

- the history of turnover and patenting expenses, since respondents believe that “it makes no sense to renew a patent if very low sales volumes are recorded in a country”;

- the number of product models to which the patent is applied, since respondents believe that “a patent is all the more important the more it is applied to multiple product models at the same time”;

- the age of the patent, which defines the obsolescence of the technology, since respondents believe that “a new technology and, consequently, a new patent can allow them to gain a new market share”;

- the forecast turnover trend of the patented product, since the respondents believe that “a product with an upward forecast trend or at least constant turnover should continue to be protected with a patent, rather than one with a downward trend”;

- the number of competitors of the patented product present on the market, since the respondents believe that “a dangerous competitive scenario, i.e. with many competitors, can be mitigated by patents, which, at least in part, discourage imitation”.

This interpretation was suggested to the managers interviewed, who accepted it, also expressing an order of importance of these criteria (Table 5.10). In particular, each respondent (8 respondents) was asked to express an importance for each criterion from 1 to 5. The summary of the results is shown below.

Table 5.10- Ranking of importance of the identified criteria

Criterion	Average value
Compliance of the patented product with the KSFs of the firearms sector (brand, design, quality/innovation)	5
Number of product models to which the patent is applied	4,5
Forecast turnover trend	3,6
Number of competitors of the patented product present on the market	3, 5
Patent age	3,4
History of turnover and patenting expenses	2,5

Source: personal elaboration.

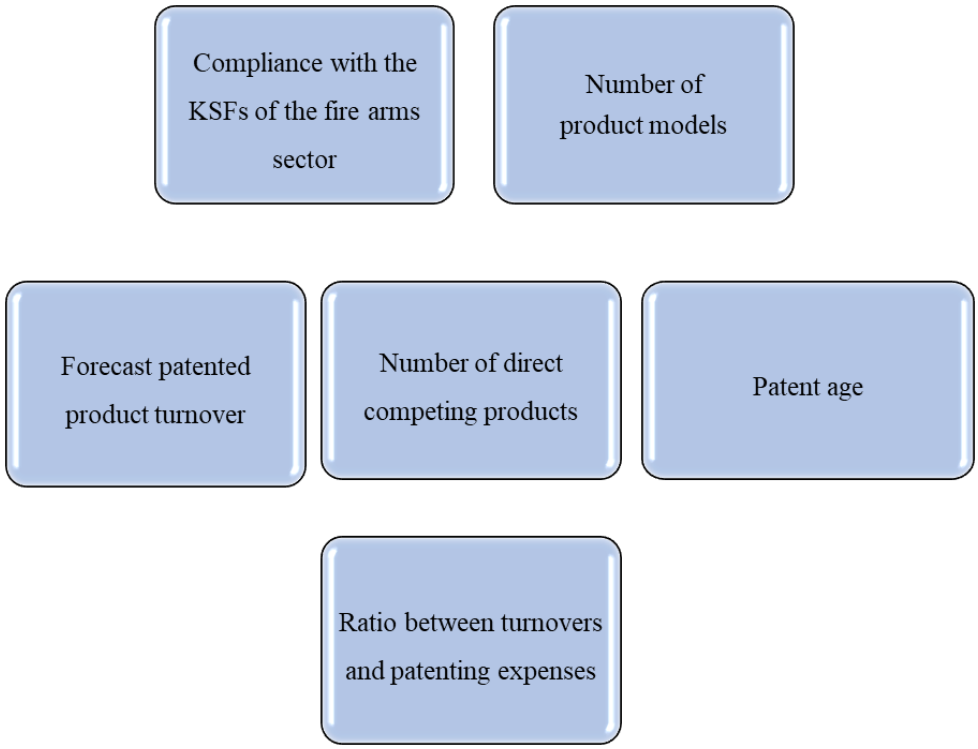
6. Criteria for evaluating patents

The criteria (reworked from the ones listed above) considered most important for the qualitative evaluation of each patent or patented product are, in order, the following:

1) the compliance of the patented product with the KSFs of the firearms sector;
2) the number of product models to which the patent is applied;
3) the forecast turnover trend of the patented product;
4) the number of direct competing products of the patented product present on the market;
5) the age of the patent which defines the obsolescence of the technology;
6) the relationship year by year and by country between turnover and patenting expenses for each individual patented product.

This ranking (Figure 5.2) will allow the development of the decision-making model for the evaluation of patents and the categorisation of company patents into strategic ones (application of criteria 1 and 2), performing ones, i.e. important from an economic and market point of view (application of criteria 3, 4 and 5) and to be monitored/not renewed (application of criterion 6).

Figure 5.2- Criteria identified for the development of the patent evaluation model



Source: personal elaboration.

Conclusions

The objective of the chapter was to answer Research Question 3 (RQ3) of the doctoral thesis and referred to below:

- ✓ *RQ3- What role do innovation and patenting play for competitive purposes in the arms sector?*

We answered the research question through the investigation of the main key success factors of technologically advanced sectors, highlighting the importance that management attributes to innovation and patents for competitive purposes in the hunting and sporting weapons business in order to achieve the advantage competitive in Benelli Armi S.p.A.

More in detail, it was decided to extend the survey conducted with the Managers of the Technical Departments, the results of which were presented in Chapter 4, also to the Commercial Managers, in order to understand whether the latter also attribute importance to innovation and to patents, even if they do not deal with them directly.

It emerged that according to the managers interviewed the main KSFs are represented by brand, design and quality, while innovation and patenting are considered less crucial for competitive success

although the company declares itself a leader in innovation in the sector and as emerged in the Previous chapter, continuous innovation is part of Benelli mission.

It is also true that, as in all qualitative analyses of this type, it is also necessary to consider what has been said "beyond the numbers"; in fact, the survey conducted made it possible to highlight the importance attributed to each KSF chosen by the company's management, bringing out the ones recognised, even if not clearly expressed with high scores in percentage terms, importance of innovation and patenting.

At the same time, respondents believe that an innovative product is also qualitatively valid, since otherwise it would not achieve success on the market and that intellectual property, specifically patents, is only one way to protect it, which however does not affect customer purchasing decisions.

From the analysis of the responses, all those interviewed believe that innovation is an element of vital importance for the company's competitiveness in the arms sector and is closely connected to quality. The average score attributed to innovation is lower than that of other KSFs, due to the fact that the importance of innovation for competitive purposes is indirectly recognised through high scores attributed to quality.

In particular, it is the President and the research staff who believe in the protection guaranteed by patents, since they discourage imitation, but in itself a patent does not help to sell more; for this reason, sales people do not attach great importance to patents for competitive purposes in the sector but are nevertheless aware of the fact that without patents the competitive intensity would increase.

Culture of innovation and patents is widespread, in particular in the technical departments, but it is necessary to diffuse it in the company.

Furthermore, innovation is closely connected to intellectual property, which is considered included in it; therefore, also in this case, the low scores that have been attributed to intellectual property for competitive purposes do not indicate a lack of importance recognised for patents in the sector but rather to the fact that customers purchase a product because it is new and innovative, not because it is patented, although, as will emerge later, patents increase the company's image and reputation in their eyes and in those of their competitors.

Furthermore, the analysis presented during the chapter had the further objective of investigating and interpreting the knowledge and perceptions of management on the topic of patent strategies and management, in order to identify the criteria considered most important by the respondents for the purposes of the evaluation of company patents.

In this regard, we reported the results in Part 1, Section B of Questionnaire 2, created to investigate the main advantages and disadvantages deriving from patenting, the interpretation of which allowed the identification of six criteria considered particularly important by the respondents for the qualitative evaluation of patents.

The interviews allowed data and information to be collected and from these considerations were drawn regarding strategies, management and evaluation of patents, which allowed the identification of criteria, then shared by managers, considered particularly important for the qualitative evaluation of patents corporate.

In this regard, the criteria identified for the development of the patent evaluation model belong to multiple value dimensions.

This interpretation was shared with the respondents, who expressed an order of importance of the indicators identified; in particular, they are: the compliance of a patented innovative product with the KSFs, the number of product models to which the patent is applied, the forecast turnover trend, the number of competitors, the age of the patent and the turnover ratio and patenting costs and allow us to categorise patents as strategic, important from an economic and market point of view and to be monitored for their renewal.

Chapter 6 will describe the hybrid patent evaluation model that has been developed, the result of integrating the results of the analysis of the prevailing literature with the results of the interviews presented in this chapter.

CHAPTER 6

A model for the evaluation of patents.

The case study Benelli Armi S.p.A.

Introduction

The objective of this chapter is to answer Research Question 4 (RQ4), reported in the Introduction to the doctoral thesis and referred to below:

- ✓ *RQ4- What are the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts?*

To answer this question, a multi-criteria decision-making model has been developed for the qualitative evaluation of patents in corporate contexts, which mainly integrates a qualitative approach with the results of interviews, to support management, focused on strategic, economic and market aspects and immediately understandable and applicable.

Furthermore, the chapter aims to apply the model to company data in order to categorise patents into strategic, important/performing from an economic and market point of view and patents to be monitored for the purposes of their renewal, in order to evaluate the opportunity to renew or not renew certain patents in certain countries to which the company being studied exports and in which it has different competitive positions and different sales volumes and to formulate proposals regarding the countries in which it is not convenient to continue patenting.

In particular, the chapter allows us to pursue the following objectives:

(i) develop a multi-criteria decision-making model, focused on strategic, economic and market aspects and immediately understandable and applicable;

(ii) categorise the company patents into strategic, important/performing from an economic and market point of view and patents to be monitored for the purposes of their renewal.

This chapter is structured as follows:

(i) the first paragraph illustrates the topics of interest;

(ii) the second paragraph describes the multi-criteria decision-making model developed for the qualitative evaluation of patents, the result of the combination of the analyses conducted in the previous chapters: systematisation of the prevailing literature on patent evaluation methods and in particular of the indicators approach and personal interviews conducted to investigate the personal knowledge and perceptions of managers and office managers relating to patent strategy and management;

(iii) the third paragraph presents the Benelli patent portfolio, grouping the various patents by age, but also presenting reworkings regarding the geographical areas and countries in which the individual patents are filed;

(iv) the fourth paragraph recalls the methodological technique adopted for the realisation of the fourth part of the case study, the results of which are presented in the chapter: personal interviews and documentary analysis of patent databases, for the purpose of categorising company patents;

(v) the fifth paragraph describes the application of the first and the second steps of the model, highlighting which patents are strategic for the company's operations and which patents are performing, important from an economic market point of view;

(vi) the sixth paragraph describes the application of the third and the fourth steps of the model, highlighting, among the patents to be monitored, the ones that should not be renewed in certain countries, proposing a critical analysis and discussion of the results.

Finally, an overall discussion of the results of the entire case study is proposed, setting out summary reflections and conclusions.

1. A conceptual premise

The evaluation of intellectual property and, specifically, patents can help in the more conscious management of these assets. Different objectives and audiences involve the application of different patent evaluation approaches/methods (Flignor and Orozco, 2006; Lagrost *et al.*, 2010).

In particular, if the objective of the evaluation is that of the registration of the patent in the balance sheet, the cost approach is preferable, while if the objective is the sale or licence, the income or real options approach is preferable. These methods evaluate the patent from a monetary point of view but do not offer an overall view of the patents, unlike the indicators approach, which provides an overview of the main characteristics of each of them and, ultimately, a complete value proxy expressed in the form of a score.

In particular, from the analysis of literature it emerged that the qualitative approach of the indicators appears to be the most suitable in supporting internal management in the management of patents, since it allows for an in-depth analysis of their characteristics and thus disseminates knowledge on the topic in the company.

This approach is based on the choice of a series of qualitative indicators (Razgaitis, 2002), such as, for example, geographical coverage and age of the patent, considered important by management and which are generally assessed individually with Likert scales; therefore, this non-monetary evaluation approach would suggest that patents that obtain a higher total score should be considered more important than those that obtain a lower score.

It took the form of developing specific and structured multi-dimensional and multi-criteria models, i.e. models based on a set of specific indicators for each observed dimension. In particular, in Chapter 2 the IPScore was analysed as a multidimensional approach which, in addition to the technological characteristics of the patented innovations and the legal status of the patents, takes into account the economic-financial, market and, overall, strategic indicators that concern them.

From the analyses conducted in theoretical Chapters 1 and 2, it seemed to us that hybrid valuations, which combine both “pure” quantitative methods and qualitative methods, are the most complete since the monetary value is integrated by considerations relating to quality and strength of the patent and, at the same time, the latter is less influenced by the subjectivity of the evaluation.

Two further reflections and considerations emerged from the literature analysis.

First of all, it seems that the tools or software proposed by the world of consultancy are not easy to apply given the presence of numerous indicators to interpret and evaluate.

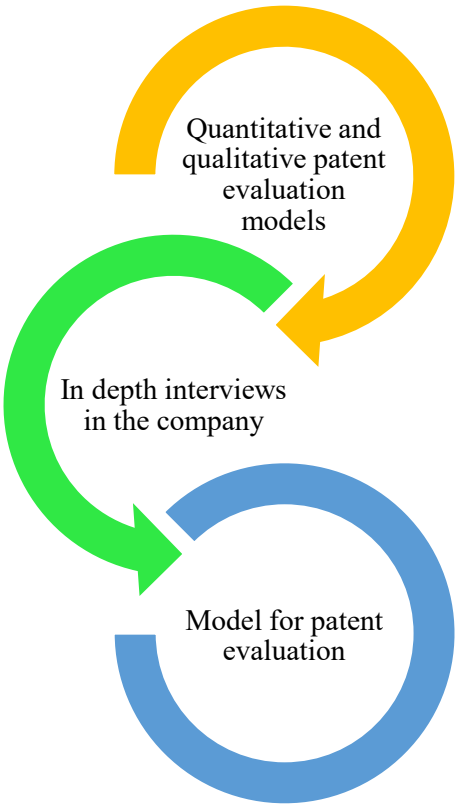
Secondly, analysing the tools of the managerial sector, the prevalence of generic tools emerges, i.e. valid for all sectors and therefore the need to develop simplified patent evaluation models specific to sectors and companies.

These aspects were confirmed by the analyses conducted in the company and presented in the previous empirical chapters, the results of which highlighted that there are "various aspects to consider for the purposes of patent renewal decisions: those who belong to the Technical Area are interested in the technological aspects of patented innovations and the legal ones of patentable innovations (and for this reason, generally supported by a specific external Patent Office) while those who belong to the Commercial Area are interested in the economic, market and strategic aspects of the new innovative products present in portfolio, whether patented or not, which will have a more or less good response on the market". However, "engineers are rarely competent in the commercial aspects and sales people in the technical ones".

Therefore, from the analyses conducted, a gap emerged in the literature on patent evaluation, namely the lack of a hybrid evaluation model, which integrates qualitative and quantitative approaches, in particular specific to the arms sector and to the company subject to study.

By integrating the analysis of the literature on patent evaluation methods, in particular the qualitative methods of multidimensional indicators (Chapter 2) with the results of the interviews with managers (presented in paragraphs 5 and 6 of Chapter 5), it was possible to develop a hybrid multi-criteria decision-making model, which combines qualitative criteria with quantitative analyses (Figure 6.1).

Figure 6.1- Development of the model

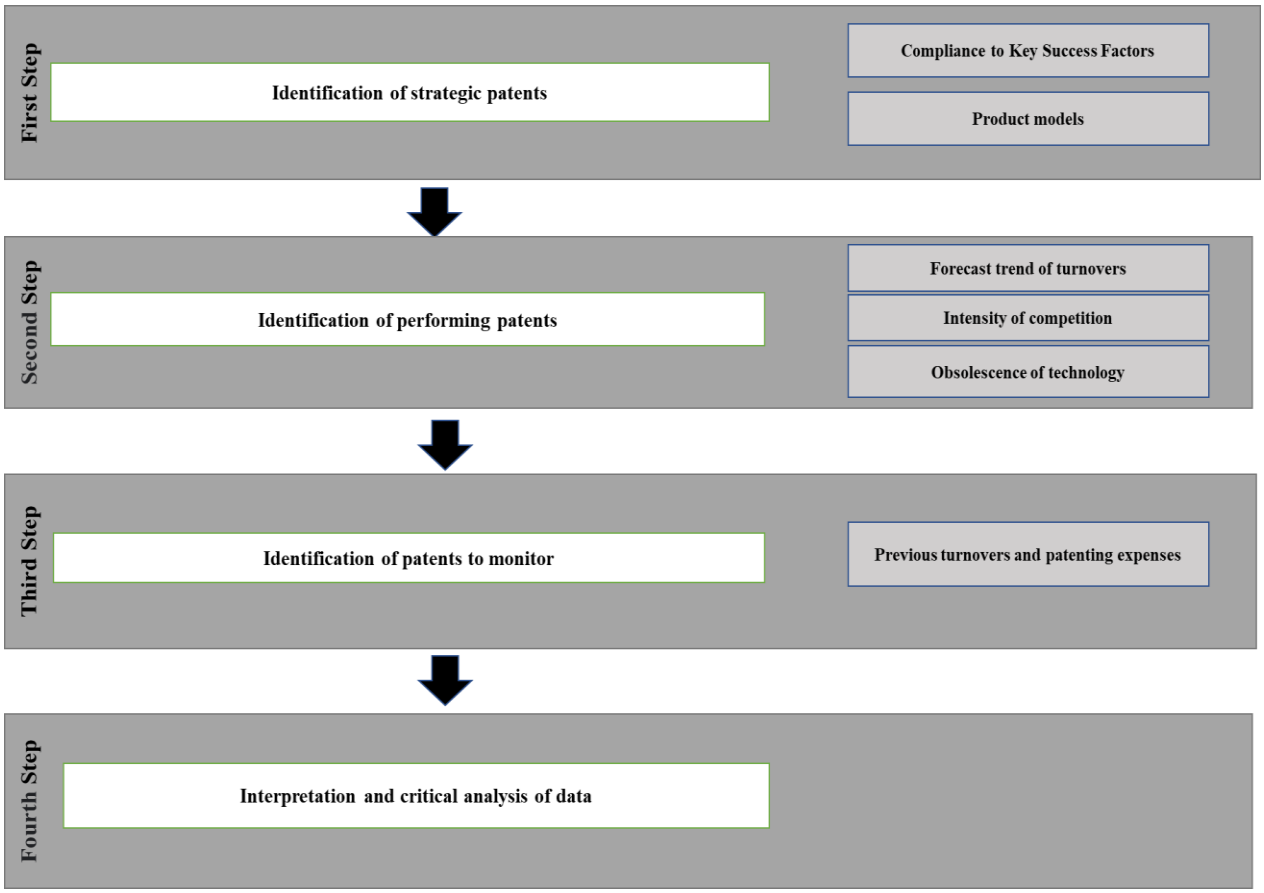


Source: personal elaboration.

2. A model for patent evaluation

The developed model (Figure 6.2) illustrates the work phases followed to provide an evaluation of the patents and to distinguish them between strategic and non-strategic.

Figure 6.2- Model for patent evaluation



Source: personal elaboration.

The model is described below, indicating at each step the criteria identified and the evaluation bands defined for the categorisation of patents, in agreement with the managers.

The use of Likert scales for this type of assessment is not new in the literature; in fact, in an important contribution (Reitzig, 2003), referred to in theoretical Chapters 1 and 2, which deals with the evaluation of individual patents in a semiconductor company, patents are comprehensively evaluated by experts (technical and marketing representatives) considering some variables (the importance of the patent for current and future technical developments; the difficulty to invent around the patent and to prove its infringement; the learning value for competitors, the number of competitors and the fact that the patent is the basis for other ones) on Likert scales.

In the present study, restricted Likert scales from 1 to 3 were defined for each criterion identified above and, at a later stage, the company patents were evaluated by the managers involved in the study on the basis of the scales associated with each criterion/variable.

Step 1

The factors that allow patents to be defined as strategic are the compliance of the innovative patented products with the KSFs of the sector and the number of product models to which the patent is applied; Patents applied to the company's so-called "technical identity" products are considered strategic, i.e. those products that identify the company in the eyes of consumers and competitors and which guarantee its success and which are simultaneously applied to multiple product models.

Therefore, a patent is strategic if it protects innovations contained in multiple products, which are consistent with the main KSFs. For example, a product with an excellent design or innovation, or a product "recognised by the market" as a qualifying element of the company offer is considered strategic and, consequently, so is the patent that is incorporated into it.

The direct interviews carried out with various managers and office managers of both the Technical and the Commercial Areas, the results of which were presented in the previous chapter, allowed the assessments regarding the main KSFs of the arms sector to emerge.

The interviewees assigned a score to each KSF in a range from 0 to 100, highlighting the extent to which each of them is considered important for competitive purposes. The results highlighted the fact that the most relevant KSFs, in the opinion of management, are brand, quality and innovation.

Subsequently, for the purposes of categorising company patents, we investigated the extent to which each specific patent responds to these KSFs and is applied to multiple product models, defining strategic bands, expressed in the form of a scale from 1 to 3, identifying three different types of patents: highly strategic, quite strategic and not very strategic for competing in the sector.

As regards compliance with the KSFs, if the patent associated with a specific innovative product has a low compliance with the KSFs, 1 point is attributed to it, if it has a good compliance with the KSFs, 2 points are attributed to it and if it has a high compliance with the KSFs, 3 points are attributed to it.

As regards the application to multiple product models, if the patent is applied to a single product model, 1 point is attributed to it, if it is applied to two-three product models, 2 points are attributed to it points and if it is applied to four or more product models, it is awarded 3 points.

In line with the evaluation scales developed, if a patent obtains an average evaluation equal to or greater than 2.5, even in just one of the two variables (compliance with the KSFs and/or number of product models), then it is considered a "strategic patent" and its evaluation does not move to the next step since there is no doubt regarding its renewal in the various countries in which it is extended.

Step 2

The factors that allow patents to be defined as performing, i.e. important from an economic and market point of view, are the forecast trend of the innovative patented product's turnover, the presence on the market of competing products, i.e. the threats of imitation that come from the competitive scenario and the patent age that defines the obsolescence of the technology.

A patent is thus important from an economic and market point of view if it is applied to products with a forecast trend in turnover that is growing, or at least constant, with many competing products (i.e. when the competitive scenario is more threatening also in terms of imitation) and recently obtained (therefore applied to new products in the portfolio).

Subsequently, for the purposes of categorising company patents, we investigated the extent to which each specific patent responds to these economic and market criteria, defining strategic bands, expressed in the form of a scale from 1 to 3, identifying three different types of patents: very important, quite important and not very important from an economic and market point of view.

As regards the forecast trend of the patented product's turnover, if it is decreasing a score of 1 is assigned, if it is constant a score of 2 is assigned and, finally, if it is increasing a score of 3 is assigned. The more the forecast trend of the turnover of the patented product grows, the greater the value of the patent, i.e. there is greater convenience in exercising the option to renew the patent.

As regards the number of direct competitors, if they are between zero and two, the competitive scenario is not very dangerous and this corresponds to a score of 1, if there are between three and five, the competitive scenario is on average dangerous and this corresponds to a score of 2 and, finally, if there are more than six, the competitive scenario is very dangerous and this corresponds to a score of 3. The more dangerous the scenario, the greater the value of the patent, i.e. there is a greater justification in continuing to exercise the patent renewal option.

As regards the age of the patent, if it is between zero and six years, the technology is considered new and this corresponds to a score of 3, if it is between seven and thirteen years, the technology is starting to be obsolete or already is and this corresponds to a score of 2 and, finally, if it is more than fourteen years old, the technology is obsolete or outdated and this corresponds to a score of 3. The more recent the technology, the greater the value of the patent, i.e. there is greater justification in continuing to exercise the patent renewal option.

In line with the evaluation scales developed, if a patent obtains an average evaluation equal to or greater than 2.5, even in just one of the three variables (forecast turnover trend, number of directly competing products and/or age of the patent), then it is considered a "performing patent" that is important from an economic and market point of view and its evaluation does not move to the next step since there is no doubt regarding its renewal in the various countries in which it is extended.

Step 3

The factors that allow patents to be defined as still convenient for renewal, despite the fact that they are not considered to be strategic or particularly important from an economic and market point of view, are the turnover of the patented innovative products and the patenting expenses, recorded over the years.

In this phase, together with the company managers, we identified the parameters useful for identifying the patents for which the renewal option is appropriate from both an economic and competitive point of view. They were identified in sales volume and patenting expenses.

Therefore, patents considered non-strategic and not even particularly interesting from an economic and market point of view can be analysed in terms of the relationship between turnover of the patented innovative product and patenting expenses, in order to observe whether sales from year to year justify these expenses, without prejudice to the fact that the factors that determine the success of the product market are innumerable.

It should be noted that the values were defined with the Technical Management and for reasons of data sensitivity they were scaled.

As regards the ratio between the turnover of the patented innovative product and the related patenting expenses for each patent to be monitored in each country, if it is less than 390, the patented product is not performing and a score of 1 is assigned, if the ratio is between 390 and 1950, the patented product performs poorly and a score of 2 is assigned and, finally, if the ratio is greater than 1950, the patented product performs extremely poorly and a score of 3 is assigned.

Step 4

The results obtained were subjected to a critical analysis and proposals were made regarding the countries in which, based on the criteria adopted, it does not appear convenient to exercise the renewal option.

These proposals are elaborated in a prudential manner: if the trend of the ratios (turnover/patenting expenses, for each patent in each country in which it is extended) is not linear because, for example, they have only taken on low values only in the last one or two years, it is preferable to carefully monitor the patent in one country, rather than consider it not to be renewed.

It should be noted that while in steps 1 and 2, the scores attributed by the interviewees do not take into account the strategic nature of the patents in the individual countries where they are extended, since the patents are considered universally strategic or not for the company's operations in all markets, in steps 3 and 4, a specific analysis by country and year was carried out for each patent.

By conducting personal interviews and processing company data, which allowed the model to be applied, it was possible to categorise the patents into strategic, important/performing from an economic and market point of view and patents to monitor and also formulate proposals regarding the countries in which it is not convenient to continue patenting.

For validation of the model in the company, all the criteria were applied but, at the specific request of the company for reasons of data sensitivity, an analysis was conducted which does not consider the criteria of the number of models to which the patents are applied and the age of the patent.

3. Presentation of the Benelli patent portfolio

The Benelli patent portfolio, with particular reference to patents for the company's technical innovations, is made up of 18 families:

- 12 patents have already been obtained where required in all the main areas of the world, which are the subject of analysis:
    - *Italian Patent*;
    - *European Patent*;
    - *Eurasian Patent*;
    - *USA Patent*;
- 2 patents have been granted in Italy but not in all other areas;
- 1 patent was purchased externally;
- 3 patent applications have been filed.

Below is a breakdown of the patents by age group (Table 6.1) and geographic coverage (Table 6.2 and Table 6.3).

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Table 6.1- Age of Benelli patents

Life Patents Benelli Armi S.p.A.	
Age (years)	No. of patents
0-4	2
5–8	3
9–12	5
13-16	4
17–20	1

Source: personal elaboration.

Table 6.2- Geographic coverage Benelli Patent Portfolio (focus Area 1)

	Geographic area																	
		Area 1 (including 17 countries)																
Patent	Country 1	Country 2	Country 3	Country 4	Country 5	Country 6	Country 7	Country 8	Country 9	Country 10	Country 11	Country 12	Country 13	Country 14	Country 15	Country 16	Country 17	Country 18
Patent 1	0																	
Patent 2	0	0						0	0	0						0		0
Patent 3	0	0						0	0	0						0		0
Patent 4		0						0		0						0		0
Patent 5	0																	
Patent 6		0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 7		0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 8	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 9		0	0	0	0	0	0	0	0	0	0		0	0		0	0	0
Patent 10		0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 11		0	0	0	0	0	0	0	0	0	0		0	0		0	0	0
Patent 12	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 13	0	0	0	0		0		0	0	0						0		0
Patent 14	0	To decide in which countries to request nationalization																
Patent 15	0																	

Source: personal elaboration.

Table 6.3- Geographic coverage Benelli Patent Portfolio (focus Area 2)

	Geographic area																
	Area 2 (including 9 countries)																
Patent	Country 19	Country 20	Country 21	Country 22	Country 23	Country 24	Country 25	Country 26	Country 27	Country 28	Country 29	Country 30	Country 31	Country 32	Country 33	Country 34	Country 35
Patent 1																	
Patent 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Patent 5																	
Patent 6	0	0	0	0	0	0	0	0	0	0		0		0			
Patent 7										0		0		0			
Patent 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patent 10	0	0	0	0	0	0	0	0	0	0		0					
Patent 11										0				0			
Patent 12	0	0	0	0	0	0	0	0	0	0		0		0			
Patent 13	0	0	0	0	0	0	0	0	0	0		0					
Patent 14	0	0	0	0	0	0	0	0	0	0							
Patent 15	0	0	0	0	0	0	0	0	0	0							

Source: personal elaboration.

Please note that the same number assigned to each patent and each country, presented throughout the document, always corresponds to the same patent and the same country.

Furthermore, some countries, which are not declared, do not have a direct importer but make use of those of others and the economic data concerning them have thus been merged; the number of the most important country (i.e. to which the company exports most) was made to prevail.

4. Benelli case part 4: a methodological premise

Below, the methodological techniques adopted for the realisation of the fourth part of the case study are recalled, the results of which are presented in the chapter.

In this sense, for the purposes of applying the model for the evaluation of patents in Benelli Armi S.p.A. management's perceptions regarding the identified criteria or indicators were investigated through personal interviews and through a documentary analysis of company databases.

The support of the managers and office managers at Benelli Armi S.p.A., belonging to the Technical and Commercial Areas and competent in patents and innovative products in the portfolio, allowed the company patents to be categorised on the basis of the criteria described above, which investigate various strategic, economic and market components.

The three-year period has, in fact, allowed data and information to be collected over a long period of time, allowing us to understand social actions and interactions at a functional and operational level. However, it immediately emerged that simple observation could not be sufficient to fully understand the topics under study.

In fact, alongside participant observation in the workplace, the method of gaining knowledge of research, which has always been more widespread and used in the world of social sciences, is questioning and consists of "an interview with one or more subjects, specifically selected, so that they respond to a series of questions, previously set by the researcher, with the aim of knowing the interviewee's thoughts regarding those themes that the researcher has identified as the object of his research" (Natale, 2007).

The investigation of the knowledge and perceptions of company management on the importance recognised for company patents specifically required in-depth analyses made possible by conducting personal interviews with Presidents and Managers of both the Technical and the Commercial Areas, based on a semi-structured questionnaire.

In particular, in the chapter, paragraph 5 identifies strategic corporate patents as a result of the analysis of section C of Questionnaire 2 and identifies performing patents, as a result of the analysis of section D and E of Questionnaire 2. Paragraph 6 identifies, among the patents to be monitored, the ones that are not convenient for renewal, as a result of section F of Questionnaire 2 and of a quantitative analysis conducted by calculating the ratio between the turnover of the patented innovative products and the related patenting expenses and finally, proposes a critical analysis of the results and proposals of the countries in which it is not convenient to renew.

The detailed description of the single case study method and the investigation techniques used was presented in Chapter 3.

Sections A and B of Questionnaire 2 are reported below (Table 6.4), indicating the respondents involved in the interviews. For the complete interview protocol, please refer to paragraph 3 of Chapter 3, while for the complete Questionnaire 2, please refer to the Appendix.

Table 6.4- Sections C, D, E and F Questionnaire 2 Key Success Factors and Patent Evaluation

Questionnaire sections	***Selected respondents***
SECTION C - SURVEY OF COMPLIANCE OF PATENTED PRODUCTS THE KEY SUCCESS FACTORS OF THE ARMS INDUSTRY	President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.
SECTION D- SURVEY OF FORECAST TRENDS IN PATENTED PRODUCT TURNOVERS	Marketing Manager.
SECTION E- SURVEY OF DIRECT COMPETING PRODUCTS	Marketing Manager.
SECTION F- SURVEY OF TRENDS IN PATENTED PRODUCT TURNOVERS AND PATENTING EXPENSES	President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

Source: personal elaboration.

In particular, regarding:

- criterion 1), managers' perceptions were investigated regarding the compliance of each individual patented product with the KSFs of the arms sector;
- criteria 3) and 4), a specific survey was conducted with the Marketing Manager, expert in the sales of all the products in the portfolio, whether innovative and patented or not, and in the characteristics of competing products, to identify the trends and the direct products competing in the market for each individual company product;
- criterion 6), managers' perceptions were investigated regarding the trend in the relationship between turnover and patenting expenses for each patented product; in particular, this trend was also the subject of a quantitative documentary analysis of the databases containing the turnover and patenting expenses of the patented product, appropriately reworked by revenue and expense items by year and country, in order to allow a timely calculation of the relationships between the two variables.

Regarding the data collection relating to criteria 2) and 5), however, the involvement of management was not necessary. Instead, a documentary analysis of the company patent databases was sufficient, relating to the number of product models to which each individual patent is applied and the age of each of them, although such data are not presented in the thesis as they are considered sensitive.

It is specified that once the investigation relating to criterion 1) was completed, it was necessary to reprocess the data and divide the patents into very, fairly or not very strategic.

As regards the fairly or not very strategic patents, a further investigation was conducted, relating to criteria 3) and 4) which, once completed, required data to be newly processed and the patents to be divided into very, fairly or not very important from an economic and market point of view.

As regards the patents which are sufficiently or not very important from an economic and market point of view to be monitored, a further investigation was conducted, relating to criterion 6) which, once completed, was supported by a specific documentary analysis of the database containing the turnover and patenting expenses of the patented product, appropriately reworked for revenue and expense items by year and country. This allowed the calculation of precise relationships between the two variables and a subsequent reprocessing of the data and the division of patents into ones to be renewed, to be monitored or to be suspended.

The following paragraph presents the results deriving from the application of the methodological techniques mentioned above, for the purpose of categorising the patents in the Benelli portfolio.

5. Identification of strategic patents and performing patents

This paragraph explains the application of the first and the second steps of the developed model, for the purpose of categorising the patents in the Benelli portfolio.

Step 1

The factors considered most important for defining strategic patents are those of the products' compliance with the Key Success Factors (KSFs) and the number of product models to which the patent is applied; Patents applied to the company's so-called "technical identity" products are considered strategic, i.e. those products that identify the company in the eyes of consumers and competitors and which guarantee its success, and which are simultaneously applied to multiple product models.

Therefore, a patent is strategic if it protects innovations contained in multiple products, which are consistent with the main KSFs. For example, a product with an excellent design or innovation, or a product "recognised by the market" as a qualifying element of the company offer is considered strategic and, consequently, so is the patent that is incorporated into it.

The personal interviews carried out with various managers and office managers from both the Technical and Commercial Areas, the results of which were presented in Chapter 5, made it possible to first investigate the KSFs of the arms sector, highlighting the extent to which each of them is important for competitive purposes (the total is set at 100) and highlighting the brand, quality and innovation as the main ones.

Subsequently, we investigated the extent to which each specific patent responds to these KSF and is applied to multiple product models, defining strategic bands, expressed in the form of a scale from 1 to 3, i.e. defining three different types of patents: very strategic, fairly strategic and not very strategic to compete in the sector, based on the KSFs considered most important in the arms sector and which the patented product incorporates.

In this regard, each respondent was asked to identify five patents for each type and on the basis of the answers, three points were assigned to patents considered to be very strategic, two points to patents considered to be fairly strategic and one point to patents considered to be not very strategic.

As specified, it is not possible to apply and report the results inherent to the criterion of the number of product models to which the patent is applied, for reasons of data sensitivity.

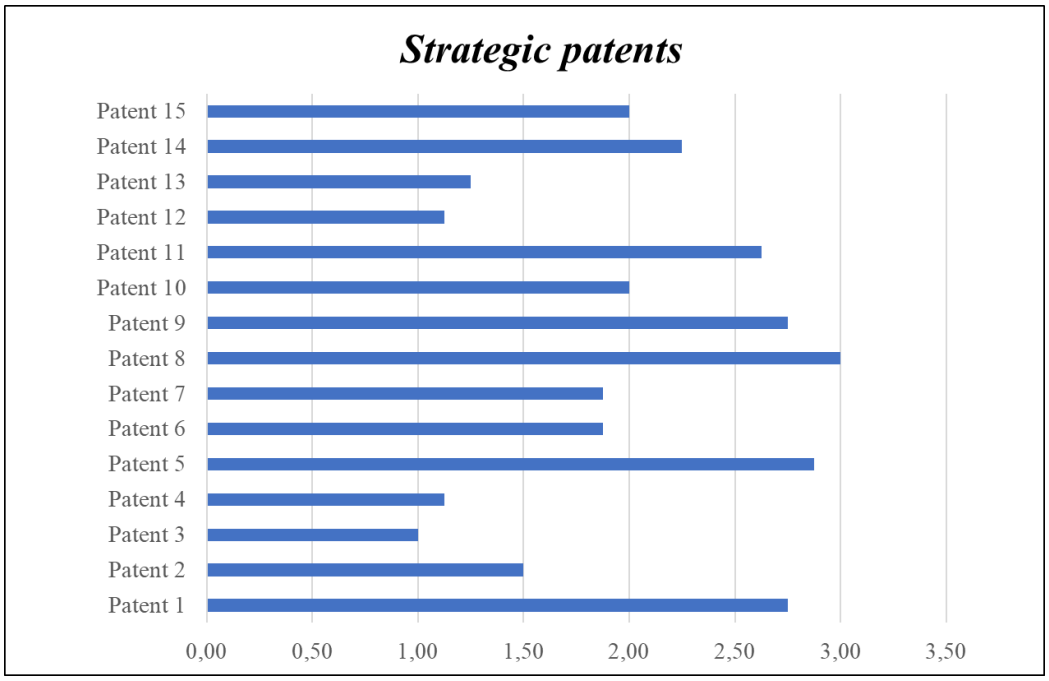
Below are the results (Table 6.5 and Figure 6.3) for each respondent which led to the identification of the strategic patents, which correspond to the following numbers: 1, 5, 8, 9 and 11.

Table 6.5- Strategic company patents

	Respondents								
Patents	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Respondent 8	**Average scores**
Patent 1	3	1	3	3	3	3	3	3	2,75
Patent 2	1	2	2	1	1	2	1	2	1,50
Patent 3	1	1	1	1	1	1	1	1	1,00
Patent 4	1	1	1	1	2	1	1	1	1,13
Patent 5	3	3	2	3	3	3	3	3	2,88
Patent 6	1	2	2	2	2	2	2	2	1,88
Patent 7	2	1	3	2	2	2	2	1	1,88
Patent 8	3	3	3	3	3	3	3	3	3,00
Patent 9	2	3	2	3	3	3	3	3	2,75
Patent 10	2	1	3	2	2	2	2	2	2,00
Patent 11	3	3	1	3	3	3	2	3	2,63
Patent 12	1	2	1	1	1	1	1	1	1,13
Patent 13	2	2	1	1	1	1	1	1	1,25
Patent 14	2	3	3	2	2	2	2	2	2,25
Patent 15	3	2	2	2	1	1	3	2	2,00

Source: personal elaboration.

Figure 6.3- Strategic company patents



Source: personal elaboration.

Step 2

The important patents from an economic and market point of view are the ones that are applied to products with many competing products (i.e. when the competitive scenario is more threatening also in terms of imitation), recently obtained (therefore applied to new products present in portfolio) and with an upward turnover forecast trend, or is at least constant.

To give value to the scores in the evaluations of the previous phase, the patents "bring with them" the points from the previous step: the five non-strategic patents with the highest total score (and, therefore overall considered on average strategic) are assigned 2 while the other five non-strategic patents with a lower total score (and, therefore, overall considered not very strategic) are assigned 1 point.

For the above-mentioned criteria, three bands have been defined for each of them.

As regards the forecast trend of the turnover of the patented product, if it is decreasing, a score of 1 is assigned, if it is constant a score of 2 is assigned and, finally, if it is increasing a score of 3 is assigned. Also in this case, the more the forecast trend of the turnover of the patented product grows, the greater the value of the patent.

As regards the number of direct competitors, if zero and two, the competitive scenario is not very dangerous and this corresponds to a score of 1, if there are between three and five, the competitive

scenario is on average dangerous and this corresponds to a score of 2 and, finally, if there are more than six, the competitive scenario is very dangerous and this corresponds to a score of 3. The more dangerous the scenario, the greater the value of the patent, i.e., there is a greater justification for continuing to patent.

As specified, it is not possible to apply and report the results relating to the patent age criterion, for reasons of data sensitivity.

Below are the results (Table 6.6 and Figure 6.4) for each respondent which led to the identification of the patents performing from an economic and market point of view, which correspond to the following numbers: 14 and 15.

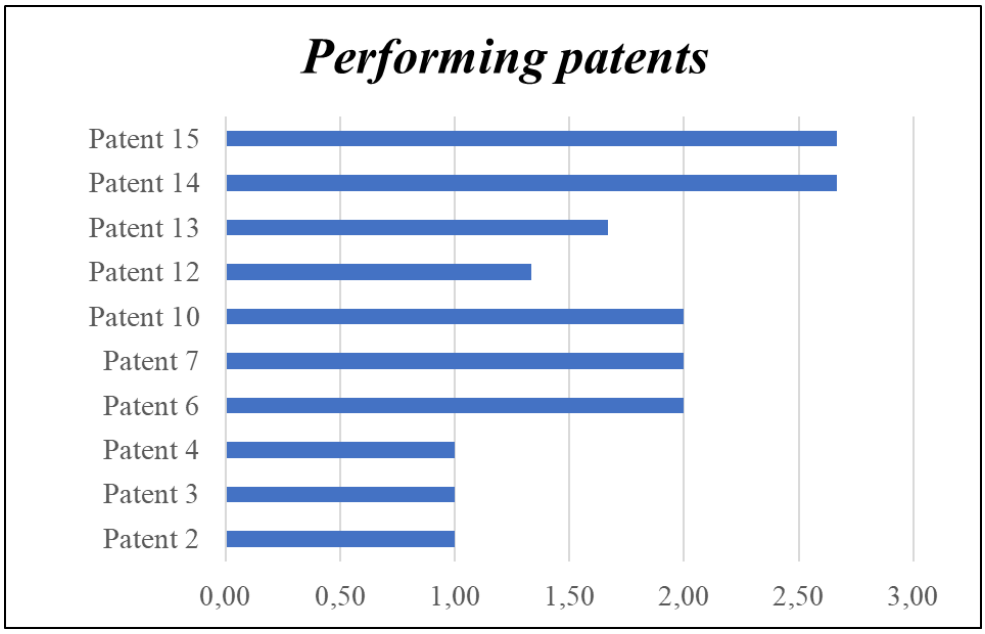
In particular, each patent brings with it the score accumulated in the previous phase.

Table 6.6- Performing patents

Patents	Strategity	Criterion 3	Criterion 4	Average scores
Patent 2	1	1	1	1,00
Patent 3	1	1	1	1,00
Patent 4	1	1	1	1,00
Patent 6	2	2	2	2,00
Patent 7	2	2	2	2,00
Patent 10	2	2	2	2,00
Patent 12	1	2	1	1,33
Patent 13	1	2	2	1,67
Patent 14	2	3	3	2,67
Patent 15	2	3	3	2,67

Source: personal elaboration.

Figure 6.4- Performing patents



Source: personal elaboration.

6. Identification of patents to be monitored and analysis of results

Patents that are not considered strategic nor particularly interesting from an economic and market point of view were analysed in terms of the interviewees' perceptions of the trend in turnover of innovative patented products (patenting costs are almost unchanged over time).

Step 3

These perceptions were found to be in line with actual turnovers, which were then used to calculate precise ratios between turnovers and patenting expenses, calculated in order to observe whether sales from year to year in each country in which the patent is extended, justify these expenses, without prejudice to the fact that the factors that determine the success of the product market are innumerable.

The data relating to the turnover of the innovative patented products were present in the company databases and it was possible to draw on them through a search by year and by country. The data relating to patenting expenses were present in the company databases but required specific processing, i.e. the aggregation of the items relating to the costs of patent filing, claims, annual payments and further costs, for each patent and for each Village. It should be noted that before 2012 there was no provision for computerised data collection; therefore, for the patents filed before that year, the data relating to that period were not present and, to reconstruct them, we opted for an

extrapolation of the available data of the other patents, through a regression function, thus analysing the different trends for the expenditure items of interest. The two variables (turnovers and patenting expenses) are therefore the result of the sum of various revenue and cost items.

It should also be noted that due to a lack of data (which cannot be reconstructed because it relates to particular patents), it was not possible to present the calculations relating to patents numbers 12 and 13.

Below are the results (Tables 6.7, 6.8, 6.9, 6.10, 6.11 and 6.12), divided by each patent analysed, which correspond to the following numbers: 2, 3, 4, 6, 7 and 10.

Each value present in the cells of the following tables corresponds to the ratio between the turnover of the patented innovative product and the patenting expenses, relating to a specific country in which the patent is extended and to a specific year. Empty cells indicate a lack of sales in that year in that country or the lack of patent extension.

It should be noted that, for reasons of data sensitivity, the values appearing in the tables do not correspond to the absolute values calculated but have been appropriately modified through the application of a conversion factor which leaves the proportions unchanged; furthermore, the elaborations of some years have been eliminated, so as not to allow us to trace the specific patent of the company portfolio, to which each single table refers.

Criterion 6

Table 6.7- Ratios between innovative patented product turnover and patenting expenses relating to Patent 2, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Country 1	22445,48	15050,28	7357,04	2697,75	1455,01	1220,90	715,92	358,96	0,00	205,96
Country 8	15727,12	11155,46	4609,28	6299,72	4502,81	1376,98	1404,06	213,59	197,08	139,37
Country 9	4572,18	4639,88	2502,79	3283,62	3608,45	443,75	1136,95	196,02	429,44	210,29
Country 10	2799,42	1592,88	1377,73	303,47	290,74	192,71	92,77	7,87	0,00	0,00
Country 16	1171,70	659,36	553,72	3634,06	1171,99	329,59	-136,41	25,31	29,74	35,34
Country 18	4119,80	7708,72	290,55	5518,81	2196,51	2246,48	1987,61	69,23	66,74	36,31
Country 19	0,00	0,00	0,00	0,00	0,00	24,45	137,29	12,51	33,18	0,00
Country 24	3020,00	457,78	383,86	76,63	169,13	0,00	638,31	94,82	348,49	53,39
Country 25	0,00	578,63	2025,54	1902,66	909,71	804,18	870,07	980,54	843,66	406,50
Country 28	146869,04	64495,05	85187,29	12200,53	60404,24	25320,85	20867,76	758,74	8697,63	3099,50

Source: personal elaboration.

Table 6.8- Ratios between innovative patented product turnover and patenting expenses relating to Patent 3, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Country 1	23495,05	15050,18	3794,50	2620,38	1324,65	1073,59	614,05	493,86	0,00	205,96
Country 8	17736,76	11155,46	1233,28	3550,51	2797,74	718,08	762,82	322,76	197,08	139,37
Country 9	5044,47	4639,88	515,46	2146,09	2250,12	244,44	605,46	407,29	429,44	219,31
Country 10	3157,13	1592,88	451,39	132,52	126,54	73,69	36,84	8,28	0,00	0,00
Country 16	1321,42	659,36	62,54	2396,56	765,03	166,78	0,00	93,29	29,74	35,34
Country 18	4646,23	7708,72	28,10	2140,29	884,87	821,34	748,15	226,01	66,74	36,31
Country 19	0,00	0,00	0,00	0,00	0,00	24,45	137,99	12,51	33,18	0,00
Country 24	3020,00	457,78	383,86	76,63	169,13	0,00	641,58	94,82	348,49	53,39
Country 25	0,00	578,63	2025,54	1902,66	909,74	804,18	874,53	980,54	843,66	406,50
Country 28	146869,04	64495,05	15401,68	57512,90	60404,24	2900,96	20867,76	6622,74	8697,63	3099,50

Source: personal elaboration.

Table 6.9- Ratios between patented innovative product turnover and patenting expenses relating to Patent 4, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Country 1	19499,90	13084,39	6358,12	2353,01	1267,64	1035,32	340,76	764,46	0,00	337,73
Country 8	11632,92	7968,19	3292,34	4499,80	3216,29	983,56	318,57	308,89	188,62	133,56
Country 10	2070,65	1137,77	984,09	216,76	207,67	137,65	20,76	7,97	0,00	0,00
Country 16	866,67	470,97	395,51	2595,76	837,13	235,42	-11,30	89,03	28,44	33,87
Country 18	3047,30	5506,23	207,53	3942,01	1568,93	1604,63	148,11	218,07	64,56	35,20
Country 19	0,00	0,00	0,00	0,00	0,00	24,45	137,99	12,51	33,18	0,00
Country 24	3020,00	1056,95	995,38	76,63	169,13	0,00	641,58	94,82	348,49	53,39
Country 25	0,00	1335,98	5252,35	1902,66	909,71	804,18	874,53	980,54	843,66	406,50
Country 28	146869,04	64495,05	85187,29	57512,90	12813,89	25320,85	20867,76	6622,74	996,45	3099,50

Source: personal elaboration.

Table 6.10- Ratios between innovative patented product turnover and patenting expenses relating to Patent 6, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5
Country 2	22863,75	14631,45	5963,93	20045,52	27213,14
Country 4	1748,00	1004,77	295,84	1399,94	693,27
Country 6	1111,27	1516,83	28,53	551,27	394,55
Country 7	9723,16	13416,25	668,70	2387,53	2607,98
Country 8	84466,68	72181,68	3558,72	8601,05	11404,69
Country 9	24547,57	7042,26	920,92	2537,59	1730,96
Country 10	51238,23	36426,91	1455,67	3107,21	789,27
Country 11	11992,72	283,57	35,39	1194,88	685,88
Country 12	8438,04	5260,52	298,25	2456,20	861,72
Country 13	3154,34	803,81	91,03	297,94	19,08
Country 14	1649,65	635,61	146,21	157,26	290,47
Country 15	1646,19	1330,76	4,34	248,59	137,14
Country 16	21390,17	5888,68	550,60	5215,38	2664,49
Country 17	27234,68	14464,19	595,86	3527,63	1371,34
Country 18	24377,14	18000,97	250,04	0,00	299,34
Country 19	0,00	138,61	47,52	43,22	17,04
Country 24	0,00	202,62	67,74	215,88	74,59
Country 25	13733,25	947,52	1198,22	492,50	470,86
Country 28	85346,18	20071,03	20058,47	27680,67	51034,22

Source: personal elaboration.

Table 6.11- Ratios between patented innovative product turnover and patenting expenses relating to Patent 7, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5
Country 2	9791,64	10785,07	17650,95	19319,19	26303,83
Country 4	121,25	243,59	1115,20	1362,22	675,68
Country 6	58,98	313,62	120,18	537,63	406,63
Country 7	438,79	2547,35	2818,86	2338,56	2556,91
Country 8	8577,22	15070,37	9054,07	8382,79	11126,57
Country 9	1682,90	5010,17	3742,86	3416,04	2322,09
Country 10	6681,47	6273,57	2741,62	3049,78	775,40
Country 11	482,23	57,51	182,97	1167,79	671,47
Country 12	440,11	1092,96	1124,01	2405,03	843,77
Country 13	182,42	70,13	206,53	294,76	18,87
Country 14	94,79	117,54	514,01	154,09	284,90
Country 15	74,29	299,88	21,68	242,46	133,93
Country 16	1054,81	1350,78	2679,02	5077,24	2601,55
Country 17	1497,39	3506,61	2652,11	3435,28	1335,08
Country 18	1035,49	2764,99	957,90	0,00	158,89
Country 19	0,00				
Country 24	0,00				
Country 25	14702,12				
Country 28	58560,67	30674,82	16641,14	22964,76	19008,88

Source: personal elaboration.

Table 6.12- Ratios between patented innovative product turnover and patenting expenses relating to Patent 10, divided by countries and years

	Year 1	Year 2	Year 3	Year 4	Year 5
Country 2	22376,66	14350,31	4267,56	10304,09	16446,71
Country 4	2158,35	978,70	259,75	1487,30	748,22
Country 6	1372,14	1477,47	26,30	581,63	397,29
Country 7	12005,66	13068,12	646,84	2653,90	2908,76
Country 8	104295,18	70308,69	3833,20	10295,32	11127,59
Country 9	21977,84	15148,75	992,05	4510,92	2333,46
Country 10	63266,37	35481,70	2701,16	3551,15	895,62
Country 11	14808,00	276,21	31,95	1245,12	758,73
Country 12	10418,87	5124,02	231,10	2802,80	983,31
Country 13	3894,82	782,96	79,66	289,85	18,56
Country 14	2036,90	619,12	135,32	175,75	323,14
Country 15	2032,64	1296,23	3,79	273,36	150,03
Country 16	26411,50	5735,88	509,55	5112,23	2937,30
Country 17	33628,01	14088,87	514,22	3874,51	1526,55
Country 18	30099,65	17533,88	229,23	0,00	319,19
Country 19	0,00	571,03	195,19	49,33	19,66
Country 24	0,00	834,73	278,24	246,40	86,07
Country 25	6990,60	3903,39	4921,69	562,14	543,37
Country 28	64409,76	33738,64	33717,51	46530,14	19994,53

Source: personal elaboration.

Step 4

The data collected and newly processed have highlighted a significant fluctuation over time in the relationship between sales volume and cost of maintaining patent protection in different countries. This can be explained by the fact that, especially in the first years of the product's life, the dynamics of sales in the sector and the cost of patents are not constant.

Below is a summary of the results (Tables 6.13 and 6.14) and a critical analysis of the results.

Table 6.13- Summary table of the results (focus Area 1)

	Geographic area															
		Area 1														
Patent	Country 1	Country 2	Country 4	Country 6	Country 7	Country 8	Country 9	Country 10	Country 11	Country 12	Country 13	Country 14	Country 15	Country 16	Country 17	Country 18
Patent 2	o	o				o	o	o						o		o
Patent 3	o	o				o	o	o						o		o
Patent 4		o				o		o						o		o
Patent 6		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Patent 7		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Patent 10		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o

Source: personal elaboration.

Table 6.14- Summary table of the results (focus Area 2)

	Geographic area									
	Area 2									
Patent	Country 19	Country 20	Country 21	Country 22	Country 23	Country 24	Country 25	Country 26	Country 27	Country 28
Patent 2	o	o	o	o	o	o	o	o	o	o
Patent 3	o	o	o	o	o	o	o	o	o	o
Patent 4	o	o	o	o	o	o	o	o	o	o
Patent 6	o	o	o	o	o	o	o	o	o	o
Patent 7										o
Patent 10	o	o	o	o	o	o	o	o	o	o

Source: personal elaboration.

In particular, the relationships presented for individual patents between the turnover of innovative products and patenting expenses, in different countries over time, are strongly influenced by the oscillating trend of sales: generally, the first four years of life of the new product sees a significant sales volume; after a few years it begins to settle down and this decreases the relationship between the turnover of the patented innovative product and the related patenting expenses.

Turnover is certainly influenced by various factors, which escape the analysis conducted, such as the price elasticity of demand and consumer tastes, which make new products sell more.

Also, the total patenting costs vary considerably over time, from the moment of obtaining the patent, which entails significant expenses for the company, to the requests for nationalisation in individual countries, where necessary, up to its maintenance in the various countries.

In general, we can state that, as in the case of patents, it is also possible to identify a series of strategic countries, characterised by high sales and which indirectly increase the importance of patents in order to limit imitation and at the same time non-strategic countries where the turnover volumes are lower but where the maintenance fees are at the same level as the former.

Based on the analysis conducted and the threshold levels defined with the Technical Management, the distinction between performing Patents/Countries (in green) and Patents/Countries to be monitored (in white and red) was proposed.

The distinction was made in a prudential manner: if the trend in relations is not linear (it has been in the red for a short time, the last year or two, also because goods have accumulated for sale in subsequent years) or if the country is strategic (since through it, the company sold in other countries) it is preferable to place this country in the white area, i.e. to always be monitored with caution and with little probability of being discarded.

Conclusions and Discussion of the case study

The objective of the chapter was to answer Research Question 4 (RQ4) of the doctoral thesis and referred to below:

- ✓ *RQ4- What are the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts?*

We answered the research question through the development of a multi-criteria decision-making model for the qualitative evaluation of patents in corporate contexts and the subsequent application to a large corporate database, analysed and reworked to allow such application.

This model allows us to evaluate the opportunity or otherwise of renewing patents in different countries, where patent protection is extensive and where there are different competitive positionings and different sales volumes of products, in order to support managers' decision-making processes regarding the possibility of renewing or not a given patent in a given country, taking into account the ability of the patented product to generate value and, in particular, focused on the strategic, economic and market value of patents.

From the analysis conducted, it emerged that the strategic nature of the patents that make up the patent portfolio should be investigated first in qualitative terms of KSFs; that is, patents applied to the company's so-called "technical identity" products are considered strategic (i.e. those products that identify the company in the eyes of consumers and competitors and which guarantee the company's success) and which are simultaneously applied to multiple product models.

Secondly, it emerged that the important patents from an economic and market point of view are the ones that are applied to products with many competitors (i.e. when the competitive scenario is more threatening also in terms of imitation), recently obtained (therefore applied to new products in the portfolio) and with a growing, or at least constant, forecast trend.

Finally, the patents to be monitored were subjected to a detailed quantitative analysis in terms of turnover, gross contribution margins and patenting costs, in order to observe whether the sales from year to year justify the expenses, without prejudice to the fact that there are countless factors that determine the success of the products on the market.

In general, in fact, the ratios presented for individual patents are strongly influenced by the oscillating sales trend: generally, the first four years of life of the new product see a significant sales volume; after a few years it begins to settle down and this causes relationships to decrease; turnover is certainly influenced by various factors, which escape the analysis conducted, such as the price elasticity of demand and consumer tastes, which make new products sell more.

Also, the total patenting costs vary considerably over time, from the moment of obtaining the patent, which entails important expenses for the company, to any requests for nationalisation in individual countries, up to its maintenance in the various countries.

In general, we can state that, as in the case of patents, it is also possible to identify a series of strategic countries, characterised by high sales and which indirectly increase the importance of patents in order to limit imitation and at the same time non-strategic countries where the turnover volumes are lower but where the maintenance fees are at the same level as the former.

Based on the analysis conducted and the threshold levels defined with the Technical Management, the distinction between performing Patents/Countries and Patents/Countries to be monitored was proposed. The distinction was made in a prudential manner since it is necessary to interpret the results and always monitor them with caution: if the trend in the relationships is not linear (it has been in the red for a short time, the last year or two, also because goods have accumulated for sale in the subsequent years) or if the country is strategic (since through it, the company sold in other countries) it is preferable to place this country in the white area, i.e. to always be monitored with caution and with little probability of being discarded.

Below is a discussion of the company case study as a whole.

The case study aimed to answer two research questions, RQ3 and RQ4:

- ✓ *RQ3- What role do innovation and patenting play for competitive purposes in the arms sector?*

- ✓ *RQ4- What are the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts?*

To answer the third research question, we first described the company history and strategy, focusing attention on the innovative and patenting processes. It emerged that innovation and patenting are considered very important by the managers of the technical departments. However, the overall respondents (technical and commercial) indicated brand, design and quality among the company's main KSFs, associating the latter with innovative capacity. This is due to the fact that the KSFs perceived as more important in the firearms sector, especially by commercial personnel, are linked to both "tangible" and "intangible" aspects by the consumer who associates an innovative weapon with a quality weapon and appreciates the aesthetic dimension, i.e. design, and brand awareness.

These results suggest that the KSFs of technologically advanced sectors focus more on aesthetic, symbolic and emotional aspects related to design and branding always with attention to quality rather than on the traditional ones of price which responds to the fact that the company aims at high consumer groups.

Furthermore, the results of the case study highlight that patenting is considered much less important than innovation even by the managers themselves, above all because it is believed that competitors in any case tend to imitate patented products. In this sense, patenting only partially discourages imitation and improves the company image, as highlighted by the literature on the subject.

The managers interviewed believe that it is impossible to make this distinction, while recognising that the product covered by patent guarantees a temporary monopoly situation.

By investigating managers' perceptions of the advantages and disadvantages of patenting, we managed to identify a list of criteria or indicators useful for patent renewal choices, allowing us to answer RQ4.

In particular, the fourth research question was aimed at identifying the criteria considered most important for evaluating patents and usable for making renewal decisions. It emerged that the first criterion to consider is compliance with the KSFs and the fact that that patent is applied to multiple product models. In other words, if a patent is strongly consistent with the brand, design and quality of the company, it must be considered strategic and is absolutely renewed. These products are defined by managers as the company's iconic products.

Further criteria or indicators for the evaluation of patents concern the forecast trend of turnover, the number of competitors and the age of the patent. Patents that meet these criteria are considered high-performance and worthy of renewal.

Finally, the study revealed that in the opinion of the managers interviewed, the remaining patents (non-strategic and non-performing) should be evaluated taking into consideration the following criteria: previous turnover and patenting expenses.

The survey conducted highlighted the level of awareness of managers and office managers of the various departments regarding the role of innovation and patents for the company's competitiveness and allowed an in-depth analysis of innovative and patenting strategies; thanks to the knowledge and perceptions on the topic of a qualified sample of respondents, it was possible to simplify the approaches highlighted in literature and develop a specific model. The resulting in-depth analysis allowed us to better understand the context and understand the meaning of some of the statements of the people interviewed, which otherwise would not have been possible to grasp.

Compared to the prevailing literature on the subject of patent evaluation in corporate contexts, which considers the qualitative approach of the indicators to be the most suitable in supporting internal management in the management of patents, a conceptual scheme has emerged defined by qualitative

criteria-quantities to make decisions on renewal and at the same time is a useful tool for managers in the arms sector.

The proposed model provides a conceptual contribution as it simplifies qualitative evaluation models and integrates different qualitative and quantitative criteria. Furthermore, a non-generalist but specific model for the arms sector is proposed.

This model is the result of the combination of the analysis of the prevailing literature on patent evaluation methods and the knowledge and perceptions of managers and office managers (belonging both to the Technical and Commercial Areas of a highly innovative company) inherent to the patent strategy and management.

A further result of the case study refers to the application of the model on company data, therefore providing a first test.

The model is useful for the company being studied and providing the data, Benelli Armi S.p.A., to support management in critical decisions relating to the renewal of patents (exercise/abandonment of the option) and, in general, for companies that do not have a specific IP department.

The work was carried out to respond to the knowledge needs of the company co-funding the research doctorate project with the hope that the work carried out can also find applicability in other corporate contexts, where decisions to renew or not renew certain patents are not always inspired by economic and competitive criteria, which will be proposed in our study.

The model presented can also be applied to similar companies that want to strategically manage patents, especially in those companies where there is no specific IP department and/or there is no strategic approach to patent management, although it should be remembered that the analysis of a single company case study does not allow broad generalisations in this sense and this represents one of its main limitations.

AN OVERALL DISCUSSION OF RESULTS: conclusions, limitations and future research directions

Discussion of the main results of the study and theoretical contributions

The present study aimed to answer the following four research questions:

- ✓ *RQ1- How is the managerial economic literature evolving on the topic of patent value?*
- ✓ *RQ2- What are the main characteristics of the conceptual models used for patent evaluation in corporate contexts?*
- ✓ *RQ3- What role do innovation and patenting play for competitive purposes in the arms sector?*
- ✓ *RQ4- What are the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts?*

In particular, with the theoretical part of the thesis (Chapters 1 and 2), we answered the first research questions while through the empirical part of the work (Chapters 3, 4, 5 and 6), it was possible to answer the last research questions.

The main result obtained by answering the first research question focused on the *evolution of the literature on the topic of patent value* (RQ1), consists in a systematic review of the literature by keywords on the evaluation of patents.

This review is characterised by having integrated macro and micro approaches to patent evaluation, proposing a classification of theoretical contributions distinguished by publication source and a timeline from 1990 to 2022 of the publications collected on Google Scholar and Scopus. All this has highlighted a growing interest in the topic on the part of the academic-scientific community and at the same time a prevalence of macro econometric models (see among others, Pakes and Schankerman, 1984; Schankerman and Pakes, 1986; Pakes, 1986; Sullivan, 1994; Lanjouw, 1998; Lanjouw *et al.*, 1998; Lerner, 1994; Trajtenberg, 1990; Harhoff *et al.*; 1999; Harhoff *et al.*, 2003b; Gambardella *et al.*, 2008; De Rassenfosse and Jaffe, 2018) over those applicable in micro business contexts (see among others, Parr and Smith, 1994; Pitkethly, 1997; Reilly and Schweihs, 1998; 2014; Razgaitis, 2002; 2009; Chiesa *et al.*, 2005; Lagrost *et al.*, 2010; Parr, 2018).

In this regard, we hypothesised that there is greater difficulty in conducting company case studies, also considering the fact that data collection on patents is extremely sensitive. Furthermore, the

analysis of the literature from a micro perspective highlighted a clear distinction between quantitative and qualitative methods for evaluating patents. By answering the first research question, therefore, we contributed to a theoretical advancement on the topic through an original systematisation of the literature, a temporal reconstruction of the trend of studies on the topic and categorisation of studies between macro and micro, highlighting the need for an in-depth study on the latter.

To answer the second research question, focused on the *main characteristics of the conceptual models used for patent evaluation in corporate contexts* (RQ2), the literature was analysed offering a description of all the quantitative and qualitative methods on patent evaluation, with prior reconstruction of the possible strategies to appropriate the value of innovations (example: secrecy, patenting and strategic disclosure) and the related advantages and disadvantages, focusing in particular on patenting strategies (example: offensive, defensive and leverage).

From the analysis of the available methods and tools, two important research gaps emerged: on the one hand, the need to adopt a hybrid approach, which integrates qualitative methods with quantitative analyses, and on the other to develop a specific tool for each sector/ company as those proposed so far seem to be rather generalistic.

These gaps guided the subsequent research, which focused on identifying a tool for making decisions on the renewal of patents based on specific qualitative and quantitative criteria suitable for the arms sector and the company under study. Indeed, the subsequent research questions of this study were respectively related to understanding *the role that innovation and patenting play for competitive purposes in the arms sector* (RQ3) and to identifying *the main decision-making criteria for evaluating whether or not to renew a patent in corporate contexts* (RQ4).

For this purpose, an exploratory field study was conducted, which -through in-depth interviews and participant observation- ultimately allowed us to identify the criteria to be used to develop the model.

Specifically, the main result that emerged in answering RQ3 consists of the observation that innovation and patenting are considered very important by the managers of the technical departments for competitive purposes in the arms sector.

However, the managers of the commercial departments indicated brand, design and quality among the company's main KSFs, associating the latter with innovative capacity. This is due to the fact that the KSFs perceived as more important in the firearms sector, especially by commercial personnel, are linked to both "tangible" and "intangible" aspects of the product by the consumer who associates a

weapon innovative to a quality weapon and appreciates the aesthetic dimension, i.e. the design, and the notoriety of the brand.

These results suggest that the KSFs of technologically advanced sectors focus more on aesthetic, symbolic and emotional aspects related to design and brand (Verganti, 2008; Kotler *et al.*, 2021) again with attention to quality rather than on the traditional ones of information and communication, product, product cost, product delivery and production (Sousa and Hambrick, 1989), which responds to the fact that the company aims at high consumer groups.

A further result in response to RQ3 highlights that patenting is considered much less important than innovation even by the managers themselves, above all because it is believed that competitors in any case tend to imitate patented products. In this sense, patenting only partially discourages imitation and improves the company image. Finally, from the analysis of managers' opinions on the advantages and disadvantages of patenting, we were able to identify a list of criteria or indicators useful for patent renewal choices.

It emerged that the first criterion to consider is compliance with the KSFs and the fact that a patent is applied to multiple product models. In other words, if a patent is highly consistent with the brand, design and quality of the company, it must be considered strategic and must absolutely be renewed. These products are defined by managers as the company's icon products.

Further criteria or indicators for the evaluation of patents concern the forecast trend of turnover, the number of competitors and the age of the patent. Patents that meet these criteria are considered high-performance and worthy of renewal.

Finally, the study revealed that in the opinion of the managers interviewed, the remaining patents (non-strategic and non-performing) should be evaluated from a quantitative point of view, taking into consideration the following criteria: previous turnover and patenting expenses.

Ultimately, as a last step, the indicators suggested by the managers, in order of importance, are the following: 1) the compliance of the patented product with the KSFs of the firearms sector; 2) the number of product models to which the patent is applied; 3) the forecast turnover trend of the patented product; 4) the number of direct competing products of the patented product present on the market; 5) the age of the patent which defines the obsolescence of the technology; 6) the relationship year by year and by country between turnover and patenting expenses for each individual patented product.

This is an innovative and original contribution to the arms sector, not yet present in the literature.

The last step of our work comprised the inclusion of the aforementioned criteria suggested by managers in the dimensions to be considered when evaluating a patent, allowing us to answer RQ4.

The main result of RQ4 consists in the formulation of a tool to support renewal decisions, in four steps, which involves three dimensions (strategic, market and economic), highlighted in the literature on patent evaluation methods (citation).

In essence, the tool represents both an innovative, conceptual and practical tool, highlighting the fact that qualitative indicators are important and prevalent for internal patent management, also for the sector and company examined.

However, although to a more marginal extent, quantitative indicators are also important.

It can therefore be deduced that the best approach to the evaluation of patents in the sector in question is a hybrid one, an aspect which has so far been little highlighted in the literature.

Managerial implications

The findings of this study showed that companies can valorise innovation and improve competitiveness and performance if they manage in a strategic way patent value.

The main managerial implication of the study concerns the provision of a practical tool useful for managers to make decisions regarding patenting, in particular regarding the renewal of patents in the portfolio. This is a very important aspect of business strategy but generally not adequately managed in companies.

On the one hand, academic literature offers numerous criteria for evaluating patents, both qualitative and quantitative, but not relatively simple schemes for managers and, on the other, the world of consultancy and managerial practice uses fairly tools/software and sophisticated.

Therefore, this work proposes a fairly simple model to evaluate whether or not to renew the patents of a company in the mechanical arms sector (built with the collaboration of managers but with scientific rigor. The model proposes a series of measurements to be carried out (using Likert scales) on the patent portfolio and to define from time to time the level of importance of the patents to be renewed. The model suggests that managers in the sector first consider the KSFs to identify the most strategic patents that certainly need to be renewed up to the fourth level which identifies the less strategic patents, but which still need to be renewed.

Furthermore, the work of systematizing the academic literature carried out provides managers with a sort of useful reading for understanding the state of the art in terms of patenting. In fact, the material useful to managers allows them to understand, for example, the advantages and disadvantages of patenting, the patenting strategies and the qualitative and quantitative micro-level methods for measuring the value of patents. At the end of the review of the literature we suggest using a hybrid approach to the evaluation of patents, i.e. a holistic, complete approach that integrates qualitative (strategic, competitors and market prospects) and objective quantitative evaluations (the costs incurred for patenting).

The study generally suggests the need to develop greater awareness of the importance of strategically managing patents in all company departments, not only among technicians in the R&D function and commercial managers in charge of the sales function.

In particular, a significant managerial implication concerns the marketing function as it becomes essential to communicate the strategic management of the patenting of innovative products, both through traditional communication channels (trade fairs, corporate events and print advertising) and through online channels (website, social networks such as Facebook, Linkedin and newsletter). An effort in communication would help increase corporate reputation and improve the corporate image in the eyes of consumers, competitors and stakeholders.

Although the work was carried out to respond to the knowledge needs of Benelli, the company co-financing the doctoral project financed with regional funds (eureka project), the hope is that the work carried out can also find applicability in other corporate contexts, where not always the decisions to renew or not certain patents are inspired by economic and competitive criteria that have been proposed in our study.

A managerial implication also concerns the world of business consultancy. The study suggests that consultants should provide professional support to companies also in the patent field, in terms of training, approaches and tools suitable for companies to use to ensure strategic patent management.

Finally, universities, especially of economics and management, should also give greater space to the topic of strategic patent management within the more generic strategic management of the company.

Limitations of the study and future research directions

Notwithstanding the theoretical and practical contributions of this study, there are some methodological limitations that open the possibility for future research. The first limitation concerns the restricted number of companies selected for the qualitative study: only one company, located in Central Italy, was deeply investigated.

However, this limitation is strictly connected with the explorative nature of this study, the many strengths of the company selected making it a very important and unique case study, and the characteristics of the Eureka project.

Therefore, expanding the sample by including companies located in different areas of Italy, as well as in other foreign countries, might be helpful to identify differences and similarities concerning the extent to which patent value management are implemented, along with the main motivations and factors underlying the adoption of patent value approaches within companies. Moreover, the case study is focused on an Italian company of the mechanical sector.

Future research might consider the analysis of a foreign company of the same sector (and subsector) to compare results and obtain a broader generalization of the results.

Furthermore, future studies should consider further cases (multiple case studies) of the sector with the aim of improving the proposed tool. It would be interesting to also explore other sectors and understand if it is necessary to define ad hoc tools.

Among future studies, quantitative research is very important to quantify the phenomenon of patenting and renewal. In particular, it would be useful to carry out both a survey conducted on a sample of companies that patent and a survey on companies that do not patent to understand the motivations, advantages and disadvantages, and the impact on performance. Finally, it would be interesting to also conduct quantitative and qualitative customer research to understand their perception of patented products and the value they attribute to their strategic management.

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Benelli Armi

APPENDIX

Questionnaire 1- Strategy, Innovation and Patenting

The following semi-structured questionnaire aims to investigate the corporate strategy and the approach to innovation and its protection in Benelli Armi S.p.A., a company producing weapons and ammunition in Urbino (PU), which represents the object of study in the scope of the PhD project entitled "Strategic management of intellectual property: how to generate innovation and defend it. Focus on the mechanical sector in global markets".

The doctoral thesis was carried out within the context of the 35th Cycle of the Research Doctorate in "Global Studies, Economy, Society and Law"; in particular, it is a path, connected to the Eureka Project - PhD scholarships for innovation, made possible by the active participation of the Marche Region, the University of Urbino "Carlo Bo" and local companies that have their operational headquarters in the regional territory in which to host the research project, the subject of the scholarship, in the specific case "Benelli Armi S.p.A."

The Eureka Project is an operation that the Marche Region is carrying out as part of the POR Marche FSE 2014/2020, in order to broaden the skills of young graduates and strengthen their employment potential, through a research doctorate path.

In particular, the questionnaire is divided into two parts (PART 1 and PART 2) and has a dual objective:

- to understand the company strategy, in terms of principles (fundamental values) that inspire the activities, the priority goals (mission) and the future state (vision) that the organization wants to achieve and the way in which it has evolved over time;

- to investigate the processes of generating innovation and appropriating the value it generates, at different strategic, corporate, business and functional levels.

The questionnaire was administered during personal interviews with selected respondents from the company, which aims to be an all-round innovation leader, promoting not only product and process innovations, but also organizational ones, through projects such as "Industry 4.0" and "Smart Factory". Benelli Armi S.p.A. is taken as a reference with regard to these innovative processes by many local companies, which cannot allocate large resources to innovative activities.

The questionnaire leaves ample space for the selected respondents belonging to different levels and offices and helps to outline the contents of the strategy and organization of innovative and patenting activities in the company.

PART 1

Survey of corporate strategy

PART 1 of the questionnaire aims to understand the company strategy, in terms of principles (fundamental values) that inspire the activities, the priority goals (mission) and the future state (vision) that the organization wants to achieve and the way in which it has evolved over time and is divided into two sections.

SECTION A- PRESENTATION OF THE COMPANY: FOCUS ON INNOVATION AND PATENTING

Selected respondents:

Product Development Manager; Prototyping Manager; Treatment and Quality Assurance Manager; Industrialization Manager; Sales Manager, Italy; Sales Manager, International.

1) What are the trends in the number of employees belonging to your Area in the last three years? Have they increased or decreased over time?

_____
_____
_____
_____

2) What are the turnover trends in the last three years and in particular the turnover attributable to the new products in the portfolio, i.e. those that contain product/process innovation, even if not patented.

_____
_____
_____
_____

3) How many inventions do not translate into new products, i.e., innovations?

4) How many innovations are not protected by patents?

SECTION B - CORPORATE STRATEGY

Selected respondents:

President; Plant and Industrial Manager; Product Development Manager; Prototyping Manager; Head of Sales; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

1) How would you define the set of fundamental principles and values that inspire company activities?

2) How would you define the company mission, i.e. the priority goals that the company wants to achieve?

3) How would you define the company vision, even though a summary sentence or a slogan, i.e. the future state that the organization wants to achieve?

4) In your opinion, has the corporate strategy as a whole, i.e. the set of principles (fundamental values) that inspire the activities, the priority goals (mission) and the future state (vision) that the organization wants to achieve, changed over time? If so, in what way?

   a. Yes
   b. No

5) In your opinion, does the company aim to be a leader in the sector through radical or incremental product/process innovations?

   a. Radical innovations
   b. Incremental innovations

6) According to your experience, the company is currently focusing on the development of incremental innovations rather than radical or at least semi-radical innovations, in line with a new corporate strategy or in order to meet the continuous needs of an increasingly more dynamic global market?

PART 2

Investigation of the company approach to innovation and its protection

PART 2 of the questionnaire aims to investigate the processes of generating innovation and appropriating the value generated by it, at different strategic, corporate, business and functional levels and is divided into four sections.

SECTION C- INNOVATIVE CORPORATE STRATEGIES

Selected respondents:

President; Plant and Industrial Manager; Head of Sales.

1) How would you define the business strategy at a corporate level, in terms of products and services offered and breadth of geographic scope?

    a. Market penetration (same products; same markets)
    b. Product development (new products; same markets)
    c. Market development (same products; new markets)
    d. Conglomerate diversification (new products; new markets)

_____
_____
_____
_____

2) In your opinion, has this strategy changed over time? If so, in what way?

    a. Yes
    b. No

_____
_____
_____
_____

3) In relation to the individual businesses (i.e. the families of products offered), how would you define the strategy, i.e. the way in which the company competes in each of them (without focusing on the individual reference markets)?

   The reference literature provides the following business strategies:

   - ***Cost leadership***: the company aims to become the organization with the lowest cost structure in its competitive space.
   - ***Differentiation***: the company wants to offer something unique to which consumers attribute a value capable of justifying a higher price; 'something unique' in terms of technology or aesthetics.
   - ***Focus***: the company wants to identify a specific competitive space to satisfy specific needs of a market segment; this strategy can be cost-based or differentiation-based.
   - ***Hybrid***: the company follows a combination of the previous basic competitive strategies.

Product families	Business strategies

Shotguns	☐ Cost leadership
	☐ Differentiation
	  o Technology
	  o Aesthetics
	☐ Focus
	  o Costs
	  o Differentiation
	☐ Hybrid

Over and Under Shotguns	☐ Cost leadership
	☐ Differentiation
	  o Technology
	  o Aesthetics
	☐ Focus
	  o Costs
	  o Differentiation
	☐ Hybrid

Rifles	☐ Cost leadership
	☐ Differentiation
	  o Technology
	  o Aesthetics
	☐ Focus
	  o Costs
	  o Differentiation
	☐ Hybrid

Bolt Action Rifles	☐ Cost leadership
	☐ Differentiation
	  o Technology
	  o Aesthetics
	☐ Focus
	  o Costs
	  o Differentiation
	☐ Hybrid

Pump Action Shotguns	☐ Cost leadership ☐ Differentiation o Technology o Aesthetics ☐ Focus o Costs o Differentiation ☐ Hybrid
Compressed Air Handguns	☐ Cost leadership ☐ Differentiation o Technology o Aesthetics ☐ Focus o Costs o Differentiation ☐ Hybrid

4) To what extent, from 1 to 5, would you say that business strategies are interactive strategies of price and quality i.e., they are chosen and modified in light of the strategies adopted by competitors?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

a. 1
b. 2
c. 3
d. 4
e. 5

5) How would you define the company's innovative strategies compared with those of its major competitors, in terms of capacity and management?

a. less advanced
b. equal
c. more advanced
d. don't know

SECTION D- CORPORATE INNOVATION GENERATION PROCESSES

Selected respondents:

Product Development Manager; Prototyping Manager; Treatment and Quality Assurance Manager; Industrialization Manager.

1) Who decides the lines of innovation? Who is involved in decisions about lines of innovation?

_____
_____
_____
_____

2) Are decisions regarding corporate innovation strategy made centrally (President and Executives) or are they shared with the Technical Area? That is, who sets goals, activities (i.e., procedures/methods), resources, and timelines? (Specify who decides at different levels)

_____
_____
_____
_____

3) What are the criteria that guide innovation pathways? Is there a budget?

_____
_____
_____
_____

4) From a technical perspective, how does the generation of product/process innovation take place, from when the initial idea is discussed, to prototyping and market launch/new procedure? (Functional strategies)

   a. ROLES
      - How many people are involved in product/process innovation?
      - Who are the people involved in product/process innovation? Are these people internal or external to the organization? Would you define this process as one of 'open innovation'?
   b. ACTIVITIES
      - What are the procedures in the innovative processes carried out by internal parties?
      - What are the procedures in the innovation processes carried out by external parties (consultants, designers, retailers, and end customers)?
   c. RESOURCES
      - With what tools are these activities implemented?
   d. TIMELINES
      - What are the average timelines, from when the initial idea is discussed, to prototyping and market launch?

5) What are the main sources (internal and external) of innovation?

a. Learning by doing

Internal sources

Process improvement

Employee involvement and activation

External sources

Interaction with suppliers

Imitation of Competition

Cooperation with competitors

b. Learning by using

Internal sources

Improved hardware and software used for organizational processes

External sources

Interaction with customers-users (individual/lead users, community of consumers)

c. Learning by searching

Internal sources

Finalized research of new ideas entrusted to R&D, design and marketing

External sources

Cooperation with research institutions

Intermediaries of innovation (virtual knowledge brokers, marketplaces of the knowledge/technology)

6) How do you link product innovations with process innovations? That is, does product innovation follow process innovation or vice versa? Or do they take place in parallel?

_____

_____

_____

_____

SECTION E- CORPORATE PATENT STRATEGIES

Selected respondents:

President; Plant and Industrial Manager; Product Development Manager; Prototyping Manager.

1) How would you define the current corporate patent strategy? That is, what are the main strategic goals to be achieved with corporate patents?

   The relevant literature provides for the following business strategies:

   a. Defensive, by which one wants to maintain the acquired position or improve corporate image/reputation (Old patents)
   b. Aggressive, by which you want to gain a competitive advantage in the industry (New Patents)
   c. Leveraging, whereby additional income is to be earned (Sale of patents)

2) In your opinion, has the corporate patent strategy changed over time? If yes, in what way?

   a. Yes
   b. No

3) What types of innovations are patented? Why?

4) Is it a choice of the management?

   a. Yes
   b. No

SECTION F- CORPORATE PATENT GENERATION PROCESSES

Selected respondents:

Product Development Manager.

1) Who decides the lines of innovation protection? Who is involved in decisions about lines of innovation protection?

_____
_____
_____
_____

2) Are decisions regarding corporate patent strategy made centrally (President and Executives) or are they shared with the Technical Area? That is, who sets goals, activities (i.e., procedures/methods), resources, and timelines? (Specify who decides at different levels)

_____
_____
_____
_____

3) What are the criteria that guide innovation protection pathways? Is there a budget?

_____
_____
_____
_____

4) From a legal perspective, how does the process of protecting the innovation play out if you decide to protect the innovation with specific Intellectual Property titles?

    a. ROLES
        - How many people are involved in innovation protection processes?
        - Who are the people involved in innovation protection processes? Are these people internal or external to the organization? Who decides whether or not to patent? Who manages intellectual property?
    b. ACTIVITIES
        - What are the procedures in innovation protection processes carried out by internal parties?
        - What are the procedures in innovation protection processes carried out by external parties (patent offices and consultants)?
    c. RESOURCES
        - With what tools are these activities implemented?
    d. TIMELINES
        - What is the average time frame for obtaining patent coverage?

5) Is secrecy to be preferred? If yes, when and why?

_____
_____
_____
_____

6) To what extent, from 1 to 5, would you say the company aims to patent only product and design innovations, without strategic considerations regarding the value of patents (costs to be incurred and expected cash flows)?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

a. 1
b. 2
c. 3
d. 4
e. 5

Questionnaire 2- Key Success Factors and Patent Evaluation

The following semi-structured questionnaire aims to investigate the main Key Success Factors (KSFs) of the arms industry, with a focus on innovation and patents, and to categorize the patents, into strategic and non-strategic, owned by di Benelli Armi S.p.A., a manufacturer of arms and ammunition in Urbino (PU), which is the subject of study within the PhD project entitled "Strategic management of intellectual property: how to generate innovation and defend it. Focus on the mechanical sector in global markets".

The doctoral thesis was carried out within the context of the 35th Cycle of the Doctoral Program in "Global Studies, Economy, Society and Law" in particular, it is a path, linked to the Eureka Project - Doctoral Scholarships for Innovation, made possible by the active participation of the Marche Region, the University of Urbino "Carlo Bo" and local companies that have their operational headquarters in the regional territory at which to host the research project, the subject of the scholarship, in the specific case "Benelli Armi S.p.A."

The Eureka Project is an operation that the Marche Region carries out under the 2014/2020 POR Marche FSE, in order to expand the skills of young graduates and strengthen their employment potential, through a PhD program.

Specifically, the questionnaire is divided into two parts (PART 1 and PART 2) and has a twofold objective:

- to investigate the importance accorded to innovation and patenting in the arms industry;
- to categorize corporate patents into strategic and non-strategic, based on the criteria identified by combining the prevailing literature and respondents' perceptions of patent strategy and management.

The questionnaire was administered during personal interviews with selected respondents, from the company, which aims to be an all-around innovation leader, promoting not only product and process innovations, but also organizational ones, through projects such as "Industry 4.0" and "Smart Factory". Benelli Armi S.p.A. is taken as a reference regarding such innovative processes by many local companies, which cannot allocate substantial resources to innovative activities.

The questionnaire, in part but mostly open-ended, leaves ample room for selected respondents belonging to different Levels and Offices and contributes to the understanding of the factors important for competitiveness in the industry they belong to and the positioning of the company in relation to them vis-à-vis competitors, as well as perceptions related to the strategic nature of the company's patents.

PART 1

Survey of critical success factors at the industry and company level

PART 1 of the questionnaire aims to investigate the importance given to innovation and patenting in the arms industry and is divided into two sections.

SECTION A- PRESENTATION OF THE INDUSTRY: KEY SUCCESS FACTORS AND POSITIONING OF THE COMPANY

Selected respondents:

President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

1) In your opinion, what are the main KSFs of the arms sector?

_____
_____
_____
_____

2) In your opinion, what do you consider to be, among those listed, the main KSFs of the arms sector (score each option, considering 100 as the total)?
    a. Brand
    b. Design
    c. Innovation
    d. Intellectual Property
    e. Price
    f. Quality

_____
_____
_____
_____

3) In your opinion, how important is innovation to competitive success in the arms industry? That is, is innovation a critical success factor?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

4) Regarding innovation, how does the company position itself in relation to major competitors in the industry?

_____
_____
_____
_____

5) In your opinion, how important is patenting activity to competitive success in the arms industry? That is, are patents critical success factors?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

6) Regarding patenting, how does the company position itself in relation to major competitors in the industry?

_____
_____
_____
_____

SECTION B- DRIVERS OF INNOVATION, TYPES OF INNOVATIONS AND ADVANTAGES AND DISADVANTAGES FROM PATENTING IN THE SECTOR AND IN THE COMPANY

Selected respondents:

President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

1) In your opinion, is innovation in the industry driven more by technology (technology push) or consumers (demand pull) and to what extent?

    a. Technology push
    b. Demand pull

_____
_____
_____
_____

2) In your opinion, can innovations be defined as more radical or incremental in the arms industry and to what extent?

    a. Radical innovations
    b. Incremental innovations

_____
_____
_____
_____

3) In your opinion, what are the main advantages of patenting in your industry (score each option, considering 100 as the total)?

    a. The patent protects the innovation against the risk of imitation.
    b. The patent prevents against attempts by other companies to make related innovations (blocking related patents).
    c. The patent allows for more revenue (if it is sold, to obtain licensing revenue).
    d. The patent enhances the company's reputation and image.

4) In particular, to what extent do you think your competitors imitate your products, even if they are patented?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

5) Specifically, to what extent do you think patents prevent against attempts to make related innovations by other companies (blocking related patents)?
(1 = must not be developed at all; 2 = must receive little attention; 3 = must still be developed and receive medium attention; 4 = must be developed with good attention; 5 = must be developed with high attention)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

6) Specifically, to what extent would you say an unpatented product of yours provides lower cash flows than the same patented product?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

7) Specifically, to what extent would you say the patent enhances the company's reputation and image?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

8) In your opinion, what are the main disadvantages of patenting in your industry (score each option, considering 100 as the total)?

   a. The patent involves a difficulty in proving the novelty of an invention/innovation.
   b. The patent involves the unveiling of much information.
   c. The patent involves procedural and maintenance costs.
   d. The patent involves costs for defending the patent in a court case.

9) In particular, do you think there is a difficulty in the company in demonstrating the novelty of an innovation?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

10) In particular, do you feel that in business, the patent involves revealing too much information?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

a. 1
b. 2
c. 3
d. 4
e. 5

11) In particular, do you feel that the patent involves excessive procedural and maintenance costs for the company?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

a. 1
b. 2
c. 3
d. 4
e. 5

12) In particular, do you feel that the patent entails excessive costs to defend the patent in a court case for the company?
(1 = not at all; 2 = some; 3 = enough; 4 = much; 5 = very much)

a. 1
b. 2
c. 3
d. 4
e. 5

PART 2

Survey of corporate approach to innovation and its protection

PART 2 of the questionnaire aims to categorize corporate patents into strategic and non-strategic, based on criteria identified by combining the prevailing literature and respondents' perceptions of patent strategy and management, and is divided into four sections.

As such, management perceptions of the criteria or indicators identified and shared with the managers themselves are investigated.

Specifically, the criteria considered most important for the qualitative evaluation of each individual patent or patented product are as follows:

1) The compliance of the patented product with the KSFs of the arms industry;
2) The number of product models to which the patent is applied;
3) The projected turnover trend of the patented product;
4) The number of direct competing products of the patented product in the market;
5) The age of the patent that defines the obsolescence of the technology;
6) the year-to-year and country-by-country ratio of turnover to patenting expenses for each individual patented product.

Specifically, regarding the inherent data collection:

- to criterion 1), managers' perceptions of the responsiveness of each individual patented product to the KSFs of the arms industry were investigated.
- to criteria 3) and 4), a specific survey was conducted with the Marketing Manager, who is an expert in the sales of all products in the portfolio, whether or not they are innovative and patented, and the characteristics of competing products, to identify trends and direct competing products in the market for each individual company product.
- to criterion 6), managers' perceptions of the trend between turnover and patenting expenses for each patented product were investigated; in particular, this trend was also the subject of a documentary analysis of databases containing turnover and patenting expenses for the patented product, appropriately reprocessed by revenue and expense items by year and country, to enable calculation of the ratios between the two variables.

With regard to data collection inherent in criteria 2) and 5), on the other hand, management involvement was not necessary but a documentary analysis of the company's patent databases,

inherent in the number of product models to which each individual patent is applied and the age of each was sufficient.

Finally, it is specified that once the survey presented in SECTION A was completed, it was necessary to reprocess the data and divide the patents into very, fairly, or not very strategic.

As for the fairly or not-so-strategic patents, once the survey presented in SECTIONS B and C was completed, it was necessary to reprocess the data and divide the patents into very, fairly, or not very important from an economic and market perspective.

With regard to patents of enough or little economic and market importance to be monitored, once the survey presented in SECTION D was completed, it was necessary to reprocess the data and divide the patents into to be renewed, to be monitored, or to be suspended, an analysis, however, that was subject to a specific documentary analysis of the databases containing the patented product's turnover and patenting expenses, appropriately reprocessed by revenue and expense items by year and country, in order to allow the calculation of the ratios between the two variables.

The composition of the corporate patent portfolio is shown below.

The company’s patent portfolio consists of 15 patent families covering inventions of technology, including:

- 12 patents have already been obtained where applied for (unless abandoned) in the areas of analysis:
    - *Italian Patent*;
    - *European Patent*;
    - *Eurasian Patent*;
    - USA *Patent*;
- 2 patents have been granted in Italy but not yet in all areas of analysis;
- 1 patent was purchased externally;
- 3 applications have been filed in Italy.

Selected respondents were given the following table, indicating the patent name, filing date, expiration date and a picture of the corresponding technology.

For reasons of data sensitivity, the company requested that the contents of the table be obscured.

PATENT NAME	DATE OF FILING	EXPIRATION DATE	IMAGE
Patent 1			
Patent 2			
Patent 3			
Patent 4			
Patent 5			
Patent 6			
Patent 7			
Patent 8			
Patent 9			
Patent 10			

Patent 11			
Patent 12			
Patent 13			
Patent 14			
Patent 15			

SECTION C - SURVEY OF COMPLIANCE OF PATENTED PRODUCTS THE KEY SUCCESS FACTORS OF THE ARMS INDUSTRY

Selected respondents:

President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

1) In your personal experience, what are the most valuable corporate patents, that is, those patents applied to innovative products that more than others incorporate the critical success factors of the arms industry?

   (For example, if, according to you, the most important critical success factors are design and innovation, a patent covering a new product with excellent design and innovation will be more valuable than the others.)

   Regarding KSFs compliance, if the patent associated with a given innovative product has low KSFs compliance, it is awarded 1 point; if it has good KSFs compliance, it is awarded 2 points; and finally, if it has high KSFs compliance, it is awarded 3 points.

SECTION D- SURVEY OF FORECAST TRENDS IN PATENTED PRODUCT TURNOVERS

Selected respondents:

Marketing Manager.

1) What are the forecast trends of the company's patented product turnover?

   Indicate for each patented product, whether it has an increasing, constant or decreasing forecast trend in turnover.

Regarding the forecast trend of the turnover of the patented product, if it is decreasing, the score given is 1; if it is constant, the score given is 2; and finally, if it is increasing, the score given is 3. The more the forecast trend of the patented product turnover is growing, the higher the value of the patent, i.e., there is greater convenience in exercising the option to renew the patent.

SECTION E- SURVEY OF DIRECT COMPETING PRODUCTS

Selected respondents:

Marketing Manager.

1) How many products are direct competitors to the company's patented products?

   Indicate for each patented product, the number of direct competing products.

Regarding the number of direct competitors, if they are between zero and two, the competitive scenario is little dangerous and this corresponds to a score of 1; if they are between three and five, the competitive scenario is medium dangerous and this corresponds to a score of 2; and finally, if they are more than six, the competitive scenario is very dangerous and this corresponds to a score of 3. The more dangerous the scenario, the greater the value of the patent, that is, there is greater justification in continuing to exercise the patent renewal option.

SECTION F- SURVEY OF TRENDS IN PATENTED PRODUCT TURNOVERS AND PATENTING EXPENSES

Selected respondents:

President; Plant and Industrial Manager; Head of Sales; Product Development Manager; Prototyping Manager; Sales Manager, Italy; Sales Manager, International; Marketing Manager.

1) In your personal experience, which patented company products have had the highest turnover, which ensures better coverage of innovation and patenting expenses?

It should be noted that the responses will be compared with actual ratios of turnover to patenting expenses, collected in company databases and appropriately reprocessed for the purpose.

It should be noted that the values were defined with the Technical Directorate and for reasons of data sensitivity have been scaled.

Regarding the ratio of the turnover of the patented innovative product to the related patenting expenses for each patent to be monitored in each country, if the ratio is less than 390, the patented product is not performing and is given a score of 1; if the ratio is between 390 and 1950, the patented product is underperforming and is given a score of 2; and finally, if the ratio is greater than 1950, the patented product is performing and is given a score of 3.