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Patent Analytics Applications

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Executive summary

In the last two decades, patent analytics methods have been developed, initially in the field of econometrics to measure R&D and technology innovation performance in different industry sectors and at national level, and now also at the corporate level, as they enable to better:

- Scope internal R&D projects as well as open innovation collaborations, by formally identifying the technological differentiation of internal background assets but also the most suitable partners and suppliers in terms of the robustness and complementarity of their protected know-how compared to internal assets;
- Identify and evaluate merger and acquisition targets in support to an external corporate growth strategy;
- Identify and develop additional revenue opportunities from licensing agreements and technology transfers, as an extra direct return from former intellectual property development and protection investments.

In parallel, a number of economists are proposing new models and gathering experimental evidence on the application of emerging patent analytics to the fundamental analysis of a technology company's value. This approach aims at better capturing the 70% to 80% ratio of stock valuation that is now attributable to intangible assets, a large part of which are formalized into significant patent portfolios in the case of high-tech companies. Better analysis of the latter assets is required to help both institutional and private investors select their value investment to secure mid-long term sustainable dividends beyond the short-term speculation profits derived from pure technical analysis of accounting and financial data.

In practice however, those tools are not well known yet, primarily because of the complexity of the underlying intellectual property field at the crossroads between technical, legal and business expertise. The goal of this publication consists therefore in introducing recent patent analytics fundamental works and findings, and explaining how to apply them in practice to different professional areas:

- Competitive analysis for marketing and strategy planning;
- Intellectual property and technology management;
- Fundamental financial analysis.

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Statistical analysis of patent data – state of the art

Patent data – what are we talking about?

A patent is first and foremost a law tool - a legal right to ban a set of technical claims describing in specific and precise terms a technical invention, such as a method, a system, a process, a device, etc. The claims have to be new and inventive. In exchange for this right, the inventors of their assignees commit to describing the invention for the public at large. The latter will then be allowed to freely use it once the legal right expires, usually after 20 years.

Obtaining a patent always starts with filing an application including the written description of the invention and its implementation, along with a first set of claims desired by the inventors or their assignees. This application is usually filed in the country where the invention was created. The inventors or their assignees then have a year to decide whether to expand the process internationally, for a higher fee (we then usually talk of a patent family issued from a single application), to pursue the patent only in the original country and for a more modest fee, or even to abandon the patent process altogether.

Patent applications are published at the latest 18 months after their initial filing[1]. These publications are publicly, widely and freely accessible, often in English, at the European Patent Office and at the American Patent Office. They are therefore an extremely rich source of technical information to monitor R&D activity within a given company or laboratory. The 18-month delay however may limit the usefulness of the information, depending on the sector: negligible in pharmaceuticals, but of course much more significant in information and telecommunications technologies.

The filing of a patent doesn't immediately award its owner the right to ban, since the different patent offices must first validate the novelty and inventivity of the technical claims according to their respective rules - for instance, software methods and business models could be claimed until recently in the United States but not in Europe, while the US Patent Office can perform a wider state of the art search than the European Office when looking for a proof of non-obviousness, by combining multiple third-party documents published before the patent filing.

Furthermore, patent law and rules continuously evolve, which requires the intervention of lawyers who have specialized in the intellectual property field (intellectual property attorneys). This process usually lasts between two years (in the best cases) and 10+ years (worst cases) for all parties to agree on a valid set of claims (if any), and this in every jurisdiction involved. The patent is then awarded in the corresponding country or countries (for instance in France, Germany and Great Britain for a European patent, depending on the owner's strategic choices, or more often budget) and can be enforced in a patent infringement lawsuit, but only on the final set of claims, usually narrower than the one originally requested. This is the reason why, once awarded, the patent is published a second time, also widely and freely accessible to the public, through the same channels as before. In Europe, third parties have then 9 months to oppose it by providing proof of absence of novelty or innovation, at fairly high cost.

The patent application and awarded patent publications include a full bibliographic header, which makes it possible to find the name and address of the inventor(s), the party filing the patent (usually the employer), the country of origin and the initial filing date, as well as the state of the art citations given in the patent description and process. Furthermore, the detail of the process is entirely accessible from the patent offices website, for free, which makes it possible to verify not only the actual legal reach of the patent claims but also possible third-party objections to the published claims as well as the modifications requested by the applicant during the procedure, often linked to a strategic re-orientation.

All these data, which we globally call "patent data" in this document, make up a very rich and detailed source of information about a company's, but also more and more laboratory's, technological development. They are now easily

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[1] Only since 2001 in the United States, which limits research before that date.

[2] Note: only 97 firms disappeared between 2001 and 2005 following a merger or acquisition; given this negligible number, contrary to Cockburn and Wagner, the authors grouped those with the surviving companies in their analysis.

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accessible, and can even be automatically analyzed using various, more or less specialized, softwares (semantic analysis, geographic patent analysis, etc.).

Statistical trend analysis from patent databases

Many academic statistical studies have been performed in the past 20 years using patent databases. At first their goal was to extract macroeconomic indicators [Hall2004].

In econometrics, Hall especially studied the correlation between stock valuation and **patent stocks weighted with the number of outside citations** for companies in the United States [Hall2001a] and in Europe [Hall2007] who filed for patent over a period of 30 years, in all sectors of the economy. The underlying hypothesis is that patents represent the knowledge stock of a company, in other words what constitutes, in final analysis, its value. Measures linked to patents should thus be indicators of their applicants' values.

The individual value of a patent is however often too irregular for it to be possible to exploit it statistically (for instance through straight counts), especially since some companies directly encourage patent filing by using it as a performance measure for their R&D engineers or in order to create a large stock of patents for cross-licensing, such as those commonly found in sectors such as telecommunications [Hall2001a] [Corbell2007]. A better performing indicator is thus obtained by weighing the number of patents with the number of patent quotes (forward quotes of the patent by a third party) - assuming that those quotes represent the effective diffusion, and hence the value, of the underlying knowledge. In practice, only 1 in 1000 patent is quoted more than 100 times, and the statistical analysis performed by Hall has shown that an **average of over 20 quotes per patent corresponds to a 54% increase of the market value of the filing company, for a given set of R&D investment and patent stock reference** [Hall2001a].

In [Hall2001b], the **quote-related indicators** are discussed more in detail. Noting that the number of quotes, both backward and forward, associated to patents have increased in the 1970s and the 1990s, and that the average number is different depending on the technological sector, the authors propose to use relative rather than absolute methods, i.e. benchmarking approaches:

- **"Fixed Effect" Approach**: The citation indicator is weighed in relation to the average number of citations received by patents in the same group and in the same period; this way, a patent receiving 11 citations in one group that received an average of 10 citations will be measured as performing slightly better than average; it will be deemed as good as a patent receiving 22 citations in a group receiving an average of 20 of them, but performing much worse than a patent receiving 3 citations in a group that gets only one on average. This approach allows, among other things, to avoid the truncation problem (citations not yet received) for recent patents.
- **"Quasi-Structural" Approach**: the citation indicator is corrected more finely by using structural hypotheses, for instance relative to the evolution of the quote distribution over time. This approach yields less noisy statistics, but only when solid econometric hypotheses are available, so it's a priori better adapted to indicator measures on large databases.

More recently, a composite **"value" indicator** taking into account **forward citations, the technological impact measured as the number of international classes awarded to the patent, and its geographic impact measures using its family size,** has given better results, but only for USPTO patents. In this context, the technological impact measure in particular can be obtained through two **specific "generality" and "originality" indicators** taking into account the repartition in fewer or more USPTO classes of forward (for "generality") or backward (for "originality") citations. Finally, an indicator of the patent "**width**" or "**impact**" can be computed by counting the number of claims [Hall2001b] [Hall2007].

Patent indicators and technology/product lifecycle

Beyond statistical research on patent databases for the purpose of identifying global economic trends, an even more interesting application of patent analysis is the search for indicators associated to a given sector. In particular, since patents are a priori a reflection of innovation, the corresponding indicators need to reflect the latter's economic models,

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in particular the **product lifecycle models** (PLC model) commonly used in strategic marketing [Grandstrand1999, p.59]. This model divides the life cycle of a product in various phases corresponding to specific cash-flow levels: development, growth, maturity, saturation, decline (**Figure 1**).

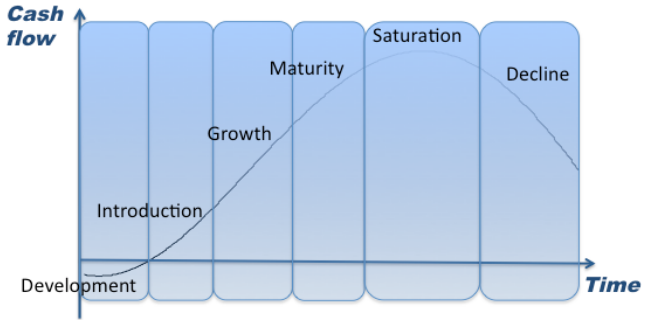

Figure 1. Product lifecycle phases.

In the first phases of development and introduction, the innovations are radical and come from a limited number of stakeholders. As far as patents are concerned, this translates into a limited number of patents, clustered among a small number of applicants, with fundamental claims of wide reach that will then be widely referenced.

Once the technical and commercial uncertainties are resolved, the **growth** phase is marked by incremental innovations - in particular secondary applications and manufacturing processes optimization [Grandstrand1999, p.223]-, developed both by the pioneers and new entrants in the field. As far as patents are concerned, this translates into an increased number of filings, a larger pool of applicants, and a reduced scope of the claims, until is reached a stability level corresponding to the **maturity** phase.

Finally, once the innovation potential in the field is exhausted, the **saturation** and **decline** phases translate into a decrease in the number of patent filings.

On the macroscopic level, by studying the patent stocks accumulated over a sliding period of 30 years in 56 groups covering all 399 USPTO technological classes recorded from 1980 to 1990, Andersen extracted 106 representative curves of **technical development cycles in "S"**, characterized by a succession of depression, recovery, prosperity and recession phases interrupted by crises [Andersen1998]. Grouping the data slightly differently and using more data (from the 1960s to 1999), Hall showed that the **proportion of patents associated with conventional sectors such as chemistry and mechanics has constantly decreased compared to that of patents in information and biomedical technologies**, in accordance with the latters' expansion since the early 90s [Hall2001b].

On a more practical level for corporate application, in [Haupt2007], the authors of a complete study of the patent indicators linked to a very specific technology at maturity, the pacemaker, proposed patent indicators that allow for the identification of the introduction, growth and maturity phases of the product lifecycle that don't require a full analysis of the patent filings in the corresponding domain - the patent filing analysis of the two main competitors in the field is sufficient. The indicators proposed by the authors are as follows (**Figure 2**):

1. **Backward citations to the literature excluding patents** - assumed to increase between the introduction and the growth phase, then to stagnate.
2. **Backward patent citations** - assumed to increase throughout the cycle from product introduction to maturity.
3. **Age difference between patent and backward citations** - assumed to be significantly shorter in the growth period (frequent incremental innovations) than in the introduction and maturity phases.
4. **Forward citations** - assumed to decrease between the introduction phase (radical innovations, foundations of the technology which have to be widely referenced) and the growth phase (incremental innovations, more specific branches that are referenced only by subsequent improvements, necessarily less numerous).

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5. **Dependent claims** - assumed to increase with the product maturity, since the domain is already mostly patented, in order to offer a fallback position to the applicant.
6. **Priorities** - the filing of refined texts linked to a first priority is essential practice, especially since the environment is very competitive. This is why the authors of [Haupt2007] hypothesize that the number of citations to anterior priorities increases as the product matures.
7. **Investigation duration** - the authors of [Haupt2007] hypothesize here that the investigation phase is longer in the introduction phase, characterized by radically new and large claims requiring unusual research by the patent officer, but also in the maturity phase, characterized by an abundance of prior art to analyze.

The experimental validation of those hypotheses through analysis of the patents of the two main competitors in the pacemaker field shows that they are mostly valid in the case of the passage from growth to maturity phase. The results are however less significant for the passage from introduction to growth phase. Furthermore, because of the technology used for experimentation, the pacemaker, it isn't possible to study the following phases, given its youth [Haupt2007].

Other, more recent studies have shown the validity of Haupt's approach in other technological fields and on a longer lifecycle, but are unfortunately not available, to our knowledge, in the public domain. Two additional indicators, mentioned more recently in the OECD manual should permit a more detailed analysis [OECD2009]:

8. **Technological accumulation**: the tendency of a company to reference its own patents can indicate an effort to maintain its leadership position in a given sector and can, in extreme cases, introduce a bias in the measurement of indicators based on citations;
9. **Technological cycle duration**: the median value of backward citations can indicate, when applied to a given company, its technical innovation speed with regards to the state of the art compared to its competitors. We can hypothesize that a company's citations analysis anticipate the global trend, in particular in regards to the lifecycle transitions, but, as far as we know, this hypothesis hasn't yet been verified experimentally. We also have to remember that this value is in practice very dependent on the sector (8 years on average, but only 3-4 years in semi-conductors, for instance).

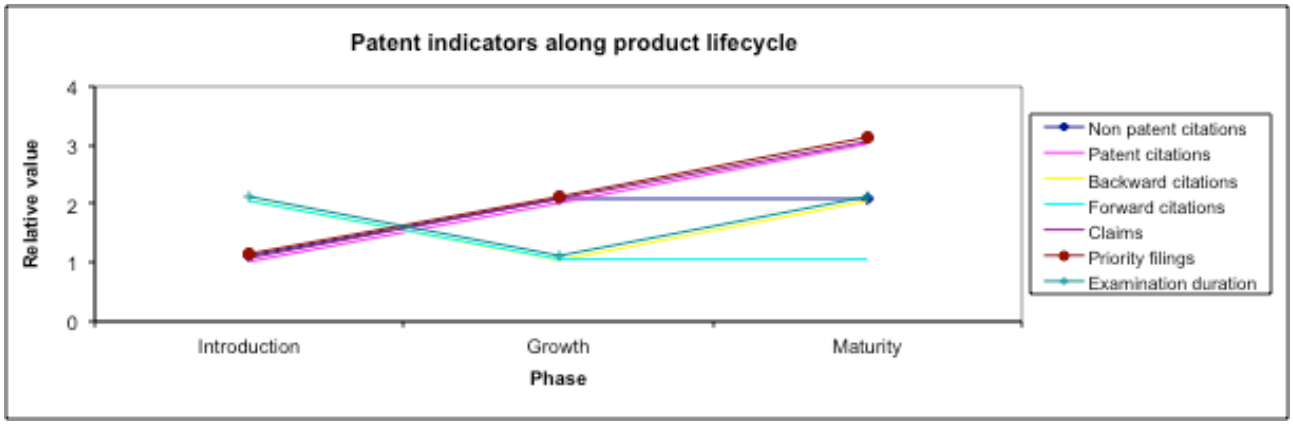

Figure 2. Patent indicator transitions with respect to the product lifecycle phases.

One of the main advantages of the evaluation of a technological market's lifecycle phases using patent indicators is that the **data relative to patents is available ahead of the market data,** since they are directly linked to the companies R&D investments, and so ahead of products commercialization. This type of analysis is of particular interest when correlated with other, more conventional information sources, especially when performing strategic planning or choosing mid- to long-term investments.

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Patent indicators and company valuation

One of the newest and most promising areas in econometrics research focuses on the valuation of companies based on their patent stock. This work, initiated by Hall's observations regarding the correlation between patent citations and a company stock value [Hall2001a][OECD2009], has blossomed in the past 5 years.

Cockburn and Wagner studied the link between the survival rate of companies first listed on the Nasdaq during the internet bubble at the end of the 90s and the valuation of their patent stock [Cockburn2007]. In order to measure the patent quality, the authors counted the number of patents awarded by USPTO, EPO and the Japanese Patent Office, as well as the family size (number of international extensions) and the number of citations by patent and by claim for the awarded patents. In practice, less than half of these companies had patents, and 2/3 were delisted from Nasdaq before 2005; the authors show that the companies listed on the Nasdaq that had filed at least one technological patent (with the exclusion of the business model patents) had a survival rate 34% higher than the others. On the other hand, the quality of those patents, quantitatively measured using the number of forward citations in particular, only marginally contributes to the company survival rate; it is more often associated with an exit from Nasdaq via a merger or acquisition, underlying the importance of formalizing intangible assets through quality patents in anticipation of those operations.

Helmers and Rogers [Helmers2010] measured the **survival rate over 5 years** of the 162,000 limited liability companies founded **in Great Britain in 2001** as a function of their innovation rate, measured through their intellectual property filings activity: patents, which characterize invention, i.e. the beginning of innovation formalization, but also the trademarks, which are more specifically linked to commercialization, hence to the passage from innovation to exploitation. Of the 162,000 firms founded in 2001, less than 2% protected their intellectual property in either form, and 70% of the total survived to 2006[2]. As in the Nasdaq case, and even in this large number of companies of all shapes, sizes and sectors, the authors show that the newly founded British companies having filed for patents have a higher survival rate than the others (16% higher), and the correlation is even higher in the case of a patent filed at the European rather than just United Kingdom level. It is no surprise that the impact of the patents on the survival rate is more significant in the technological sectors, in manufacturing, information technology, R&D and services, while is it marginal in the financial, real estate and retail industries. On the other hand, the trademarks, by nature more general, correlate with a higher survival rate in most sectors. It is to be noted that this study also shows a positive correlation between geographical proximity with a university and company survival rate.

Hypothesizing that a company's value is increased by its ability to differentiate itself, especially on the technological level, Czarnitzki and Kraft set out to measure in German companies the correlation between patent stocks and profitability, measured as the ratio between their profits and their expenses. They showed that in their sample, a patent stock increases the company's profit margin by 0.7% on an average 4% basis compared to the patent-less companies [Czarnitzki2010].

In the same way, and more recently, Neuhäusler, Frietsch, Schubert and Blind directly measured the **correlation between the patent indicators, used as approximation of R&D performance, and the financial performance of a company** [Neuhäusler2011]. To estimate the latter, the authors used not only stock information, but also a return on investment measure (ROI - profit before interest and taxes, divided by the sum of assets) and Tobin's q factor, indicating respectively the immediate and anticipated profitability of a company, of particular interest when looking to invest for value and dividends rather than speculation (stock market value). The authors used in their analysis a sample of 479 companies actively investing in R&D, listed between 1990 and 1997 on the English index DTI-Scoreboard. In this sample, the gross quantitative measure of the patent number is too noisy to be statistically significant regarding the gross company performance in the market, but nevertheless gives a positive correlation with the return on investment. Furthermore, **a refined analysis using complementary qualitative indicators such as the international family size, the citations number and the proportion of oppositions, the value of a company on the market seems directly correlated to the quality of its patents**.

[2] Note: only 97 firms disappeared between 2001 and 2005 following a merger or acquisition; given this negligible number, contrary to Cockburn and Wagner, the authors grouped those with the surviving companies in their analysis.

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Those studies, fairly recent and little known outside of academia yet, suggest that it should be possible to predict a technological company's financial performance using patent indicators. It is particularly true in the chemical, pharmaceutical, information technologies and telecommunications sectors, and to some extent the electronics and mechanics sectors [Neuhausler2011]. Such measures are likely to be developed in the coming years, in particular to support analyses aiming at mid- to long-term investments geared toward profitability (dividend distribution) rather than speculation (stock price increase) of a company.

Theoretical limitations and practical uses

In spite of the ease of access to patent data, it is important to keep in mind that they come with limitations. Grandstrand [Grandstrand1999, §9.2.3] lists fifteen of them.

In particular:

- **Regarding filings**: not all innovation results in a patent. Some companies prefer to base their technological differentiation on manufacturing secrets. Furthermore, many patents don't lead to a commercial application, and don't necessarily correspond to an innovation (especially the published patents that haven't yet been investigated). There are also differences between sectors, both in terms of the practice in patent filing and in terms of patent quality, which makes comparing filings across sectors difficult [Grandstrand1999, §9.2][Okubo1997].
- **Regarding patent assignees**: in the case of a historical evolution analysis, company name changes, for instance in the case of a merger-acquisition, are not documented in the public patent databases after publication. When a specific company is being benchmarked, it is thus necessary to take into account its successive names. Furthermore, some multinational companies file patents using subsidiary names, depending on their organizational strategy, which introduces a bias in the number of applicants, for instance when benchmarking by activity [Hall2001][Hall2004][Corbel2007].
- **Regarding citations**: the main limitation to the use of citations is time, since a recent patent hasn't yet received all the citations it will receive [Hall2001b]. Qualitatively, bibliometric studies differentiate citations by the applicant from citations by the independent examiner [Okubo1997]. The applicant's citations are used as part of a decoy tactic by some companies, while the examiner's citations can be biased by their legal value, as well as by the not-necessarily-complete knowledge of the technology by the examiner himself/herself[3]. Hall also distinguishes the self-citations between patents of a single applicant from third-party patent citations, showing that the former are more strongly correlated with the increase in market value of the applicant.
- **Regarding data availability**: patents are published only 18 months after initial filing in most cases[4], which can be after arrival of the resulting product on the market, in particular, when the patent is in the information technologies and communications sectors, or when it is filed at the end of the R&D phase [Corbell2007].
- **Regarding data analysis**: all academic studies apply at the very least a time smoothing algorithm on the data to highlight the basic trends and reduce the non-significant variations that can be seen in such large data sets. The authors of [Haupt2007] insist strongly on the need to process the raw data with statistical analysis tools (such, in their experiment, variance analysis according to Scheffé's test) to avoid hasty conclusions regarding lifecycle phase changes on the basis of transitory variations in the patent indicators.

In practice, it is possible to avoid some of those limitations:

- **By comparing the analysis results with other sources of information**, such as market and competition information, or expert knowledge of the technological field, easily accessible within companies or if need be from consultants specialized in the field, in order to verify the relevance of the data.

[3] The applicant's knowledge of the field himself however seems even more limited if we take into account the fact that 40% of the applicants learn of anterior art from the investigation report [according to Hall2001]
[4] Before 2001, at USPTO, patents were published only after having been awarded, which limits the analysis of patent applications before this date to those filed or extended outside of the United States.

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- **By repeating the analysis at regular intervals**, ideally by systematically integrating it with the technology and competition monitoring activities within the company: this will allow to detect new publications and trend changes as early as possible in the technologies lifecycle and thus win by anticipating disruptions, erosions and evolution opportunities as upstream a possible from their commercial consequences.

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Application to strategic and competitive intelligence

Competition analysis using patents

Traditionally, the patent analysis of the competitors of a company has focused on targeted monitoring activities, more qualitative than quantitative:

- Strategic monitoring, allowing for instance to anticipate the appearance of a new competitor;
- Technological monitoring, allowing to anticipate the evolution of competitors' solutions by monitoring their patent filings.

Along with the development of the patent indicators in the econometrics field that were discussed in the last chapter, various quantitative analysis techniques are now more systematically applied in the monitoring of the competition and in the strategic planning within a given company [Corbel2007][OECD2009]:

- **Filings count within a given technological field**: the analysis of the applicants and of the number of filings evolution can highlight competitors' changes in strategy, but also market developments, the arrival of new competitors, or the arrival of substitutive technologies.
- Number of patent filings linked to the R&D investments of the different actors within a given sector; **global benchmarking**. This is sometimes used to measure the relative strength of the R&D and patent portfolio among different companies, especially in Japan;
- Filing evolution within an IPC (International Patent Classification) class: **benchmarking by technological sector** - then possible to highlight historical, geographic, etc. trends.
- **Quantitative analysis based on cross-citations between patents (citees and citers)**, an often cited patent usually being a quality patent; more specifically, for a company owning a foundational patent, the monitoring of "secondary" patents citing the former (improvement or bypass technologies) can allow them to identify and anticipate the arrival of new competitors while identifying possible infringers or counterfeiters that the patents allow to defend against.
- **Analysis of patent expirations and licensing agreements** - this latter technique is however very limited by the difficulty to access this information, usually kept private.

In practice, the study of the patent landscape for a given technology allows for the identification of various indicators, some of which are very easy to measure from the patent databases, such as the historical evolution of the number of filings or the quantitative characterization of their strength by the measure of the forward citations made. These indicators can be used for benchmarking in order to position one's own R&D or patent portfolio with respect to the competition and to take the necessary corrective measures as upstream as possible in the strategic planning (preferably before litigation reveals possible weaknesses!), but also to determine at which phase in the product lifecycle a technology is at, before market data comes in, which is especially interesting in strategic marketing.

Such an analysis is perfectly complementary to the ones done at the sales/marketing and strategic levels: it overall leads to "bushier" data because "noised up" by technological developments that don't lead to a commercial product, but it has the advantage of being available in advance of implementation on the effective positioning of the different market actors. The competitive evolution indicators based on patent activity in a given sector are especially valuable to identify as early as possible the threat of arrival of substitutive technologies on a company's main markets.

In merger-acquisitions and in open innovation operations implying a technology transfer between companies, the patents owned by those companies are en essential element in their valuation and make the legal aspect of the operation easier not just in the short term, but also in the mid- and long terms [Frohling2008]. The patents give the best guarantee that the unique technological know-how that justifies the investment in the collaboration is formalized and protected, independently of the human resource management, often tricky in this type of operation (inventor founder of a young technology company during purchase, lab researcher contracting the collaborative innovation project, etc.).

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Patent data quantitative analysis is however limited because we lack insight regarding the most recent technologies (18 months delay before filing publication, and number of backward citations under-estimated in the first years after publication). Therefore, a qualitative analysis, as well as a regular data update, remains necessary in practice. It is absolutely possible to develop this qualitative analysis from a combination of the information available in-house with the R&D (patent monitoring) and product, marketing and business development teams (strategic competition/marketing monitoring), this at different stages of the product and innovation development, given a minimum of training and collaboration of the involved teams.

Development and generalization of synthesis tools

Patent data analysis was until now limited to specialized experts or patent engineer-technological specialized partners who mastered both the technological and legal aspects of the patents, but who often didn't know the market or the company's strategic orientation that allow to put the data in a more concrete perspective, to derive from it targeted recommendations (for instance identification of a strategic acquisition target or an opportunity for R&D study ahead of phase in an emerging field), and most importantly to present them clearly to the decision makers.

In practice, the development of software tools dedicated not only to the analysis of patent databases but also to their presentation in various graphic form, such as patent landscape cartography, make the understanding and explanation of the data much easier. Those tools and the training of dedicated experts are as of now still too expensive to be widely available to small and midsize companies, but the large groups have already integrated them to their strategic monitoring and we anticipate they will be more widely available in the near future [Caillaud2010].

What remains to be developed, along with the generalization of those tools and a better popularization of the field through training, is a more active and more systematic collaboration between the technological monitoring experts and the leaders of marketing, competition monitoring and strategic planning, so that they can compare the factual patent data analysis with the vision for products and company evolution, thus enriching everyone's recommendations.

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Application to patent portfolio management

From legal protection to business valuation

Traditionally, the management of Intellectual Property (IP) within companies specialized in two main directions, strongly legal or strongly technical:

- Acquisition of IP rights: creation and maintenance of a portfolio of patents, trademarks, drawings and models, whose goal is to formalize and legally protect the company's or research institute's innovations;
- Exploitation of the IP rights: Usage of the IP portfolio titles in actions against infringement or counterfeiting, or, on a case per case basis, in technology transfers and targeted licensing agreements.

From the perspective of a company's strategy, in first approximation, good patent management consists in preserving the added-value of the company's innovations by protecting them durably against imitation by its competitors. This type of "differentiation" strategy naturally goes with the development of an innovation throughout the corresponding product lifecycle [Corbel2007]:

- filing of foundational patents as early as possible in the R&D phase;
- choice of international extensions linked to the identification of target markets;
- filing of complementary patents in the product improvement and functionality extensions phases once on the market;
- development of the patent value internally in product marketing and anti-counterfeiting lawsuits.

However, restricting the patent management to the **legal** preservation of the exploitation monopoly of a **technological** innovation within a global strategy of internal growth is very limiting. This defensive strategy is indeed not necessarily the most **commercially profitable** for the company: depending on its competitive environment, it can be more interesting to consider a more offensive strategy [Corbel2007][Grandstand1999]:

- By developing a licensing policy allowing the company to increase revenues without taking on the corresponding expansion costs (geographic expansion, diversification of an technology's applications);
- By capitalizing on a complementary patent portfolio allowing the creation of a differentiated strategy through the combination of licenses, eventually free, on some elements of the technology to encourage the latter penetration on the market, with a strong protection of the complementary patents, used as differentiators - the most well-known example of this strategy being Intel;
- By using the patents as bargaining chips in the context of cross-agreements aiming, for instance, to impose a technological standard in the market - this strategy is now widely used by the different manufacturers in electronics and telecommunications via "patent pools" linked to standardized technologies, following the lessons learned during the development of the GSM standard in Europe, or the VHS-Betamax standard war in Japan in the last 25 years.
- By applying competitive patent analysis to the technological fields identified as external growth targets in the company strategy, in order to identify and qualify as suppliers or acquisition targets the owners of essential and differentiating technologies upstream of their commercial development (for instance in the case of startups)..

In extreme cases, the company owning the IP rights can even do without factories and distribution networks, all the while being sometimes more profitable than its licensees: this is the business model adopted by the NPE, Non-Practicing Entities, also called "trolls", particularly encouraged by the legal patent system in the United States, but also more and more by large European industrial groups in electronics and communications, who now draw important revenues from their subsidiaries dedicated to the commercialization of patent licenses internationally, especially in Asia (Thomson, Philips, Alcatel-Lucent…).

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Clearly, the patent analysis and competitive monitoring tools complement conventional tools such as market studies at the definition, execution and validation stages of the company strategy when it is active in a technological field; the patent manager, who has the tools and knowledge, both technical and legal, for these analyses, must now be ready to provide them to the heads of marketing, strategy and R&D, and compare them to the other sources of market analysis and technology evaluation.

Links between competition environment and patent strategies

Competitive analysis also allows to benchmark one's own patent filing, management and use practices. A synthesis of different tools to assist strategic choices related to patents is described in [Corbel2007, p.161-168]. The author offers in particular a classification grid of the patents in a two-axes matrix (**Figure 3**):

- Patent potential according to its technological coverage of the market it addresses;
- Patent competitive impact, according to the width of its claims, its independence in relation to other patents, and its legal strength.

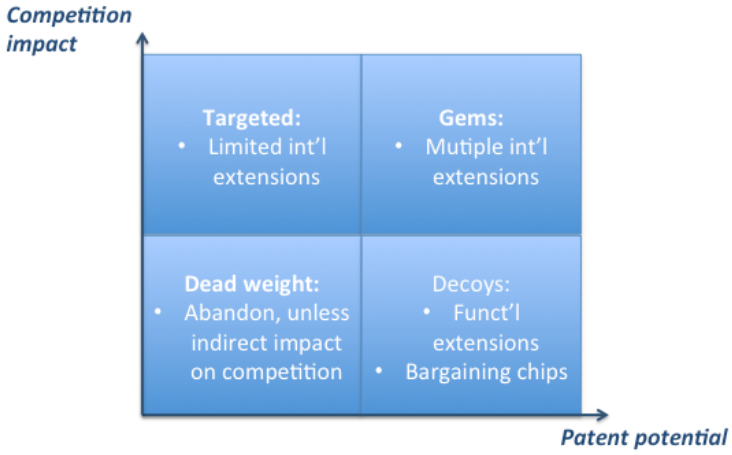

Figure 3. Patent management decision matrix.

The evaluation of these axes can be profitably informed by competitive analysis. The latter can indeed explicitly reveal the positioning of a blocking, circumvented or completed (forward reference by competitors patents) patent, or the positioning of a patent belonging to a patent barrier, ensuring a de facto legal protection or allowing to negotiate global cross-agreements (because of the high cost of a third-party detailed analysis, decoys are not always detected in the mass of patents within the portfolio).

A major change in a company's competitive environment can also lead to a modification of its global patent strategy. Grandstrand [Grandstrand1999] describes how Motorola positioned itself as owner of "blocking" patents essential to the GSM standard while the European telecommunications operators and manufacturers such as Ericsson had not explicitly given importance to the licensing agreements in the definition of the standard, which forced the latter to significantly revisit their patent strategies. The competitive environment had indeed quickly changed from national monopolies simply balanced by implicit non-aggression agreements to a situation of intensive competition where the newcomer, Motorola, appropriated, completely legally, the benefit of a technology with strong commercial potential by judicious positioning and valuation of its patents [Grandstrand1999, pp.202-205]. Here again, a competitive monitoring associated with the development of the standardization strategy would have allowed to better anticipate this situation.

More recently, one can see mass market electronics companies taking into account patent data analysis in their external growth strategy. This strategy is evidenced by their acquisition, sometimes at significant cost, of companies owning patents fundamental to a basic technology for an emerging standard, even though those companies have only low revenues from the direct commercialization of their technologies. For instance, Sony and Philips, in the beginning of the

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2000s, bought Intertrust while Thomson was taking a large participation in ContentGuard, two young companies owning patent portfolios in the area of digital rights management (DRM). Those patents apply notably to a 3rd generation telephone norm (Open Mobile Alliance) for multimedia content access from mobile equipment, but are also a way to block the arrival of software companies such as Microsoft and Apple in the content distribution on wide band networks (IPTV), making it more difficult for them to become direct competitors of mass market electronics [InfoMech2008].

Finally, the use of competitive analysis in IP strategies and policy practices is not as systematic in Western companies [Grandstrand1999], but it tends to grow along with the implementation of so-called "offensive" patent strategies, for instance in France by groups such as Thomson, Alcatel and the Pasteur Institute, probably under pressure from sector-specific dynamics [Ayerbe2006].

Product lifecycle and differentiated patent management strategies

Beyond the fairly static management strategies outlined by Corbel [Corbel2007], it is also useful to take into account the positioning of a technology within its lifecycle to refine decisions about filing, extension and maintenance of the corresponding protection by patents. Grandstrand thus oriented his modeling of IP strategies along the R&D development associated with a technology [Grandstrand1999, chap. 7], and derived six possible patent strategies:

1. Simple blocking by the applicant, simple sidestepping by the competitor - in practice the most frequent implicit strategy;
2. Search for a blocking essential patent, that cannot be designed around at a reasonable cost by the competitor - difficult to execute beyond the initial development stages of the technology;
3. Multiple coverage - systematic filing of "mine fields" on multiple components of the technology or associated processes, without systematic organization;
4. Barrier - organized filing of complementary patents that can be individually sidestepped but are unavoidable globally;
5. Circling - filing of multiple patents complementary to a fundamental patent, in order to make them indispensable to any use of the latter, so cross-licensing agreements can be forced;
6. Combined circling networks of different patents in competition.

Furthermore, patent filing will naturally evolve during the lifecycle of a technology from basic protection to implementation patents to manufacturing process improvements, while new patents will appear with the development of substituting technologies [Grandstrand1999, p.225]. Since a strong position on a basic technology can be upended by the arrival of newcomers with substitutive technologies, patent filing analysis as a reflection of the R&D investment of the competition is an essential tool to anticipate those evolutions and integrate them in the company's development strategy, by adapting R&D efforts and their protection by patents according to the constantly evolving competitive situation.

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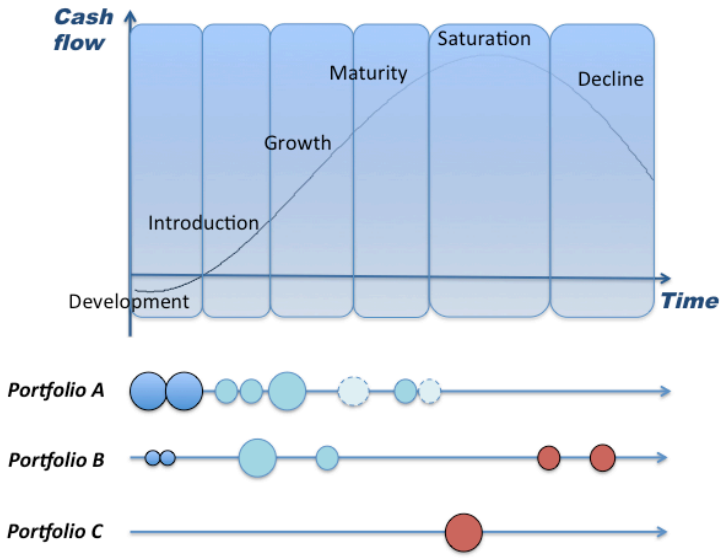

Figure 4. Sample patent portfolio development strategies along the product lifecycle.

Two examples of differentiated patent strategies along the lifecycle of a technology are presented on Figure 4: the circles represent the patents filed according to time, from left to right, in conjunction with the technology development lifecycle. In dark blue, the patents associated to the fundamental technology: the size of the circle represents the reach of the patent; the black circle line represents patents on the fundamental technology. The lighter blue circled by blue line represent the technology application refinement patents. The light blue, circled by dotted line represent process improvement patents. The arrival of patents corresponding to a substitutive technology is plotted in red. Competitor A's strategy is to improve the basic technology in order to extend its applications and reduce its costs (improved processes). Competitor B's strategy is to quickly invest in the substitutive technology, so it can stay competitive with respect to the new entrant C.

This type of formal approach to patent strategies, made explicit in the IP strategies policies defined at the corporate level, is particularly developed in the large Japanese companies.

In particular, those IP policies demand that all the rights associated with the ownership of strategic patents for the commercial development of a technology be systematically secured, in order to avoid litigation risks. Differentiated strategies are then implemented to reach this goal, as [Grandstrand1999] shows: for instance, Canon demands ownership of the patents themselves, either via internal growth (its own R&D stocks) or by acquisition, in order to guarantee a monopoly; other companies have a more nuanced approach integrating the possibility of licensing, either directly or through cross-agreements; in this latter context, a systematic patent analysis in the technological field in question allows the identification of specific tactical responses, such the circling strategy around a strategic patent, in order to make the subsequent agreement negotiation easier.

Patent management at corporate level – from systematic approach to global policy

Patent Strategy therefore gains by being refined, as the last section shows. It is likely difficult to design a global, universal patent strategy, since the state of the art shows the importance of taking into account individual competitive environments, among other things, when defining which strategy to apply. The different technologies developed by a large group or multinational company are unlikely to be homogeneous as far as competitive environment is concerned - more typically, we'll find commercialized products at different maturity stages, in parallel with further investments in new technologies development. This diversity has to be reflected in the corresponding patent portfolios, and it is thus necessary to adapt the strategy on a case per case basis.

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It seems however useful to more globally harmonize the **Intellectual Property Policy**, by explicitly formulating its main directions and by developing a **systematic methodology** allowing the entity to optimize and harmonize strategic patent management, as has been the case for a long time in the Japanese industry, and more and more in the large Western groups [Grandstrand1999][Ayerbe2006]. One then systematically takes into account the new technology positioning in its competitive environment in terms of "**patent landscape**" when making decisions regarding filing, extensions, maintenance and purchase/sale of licenses.

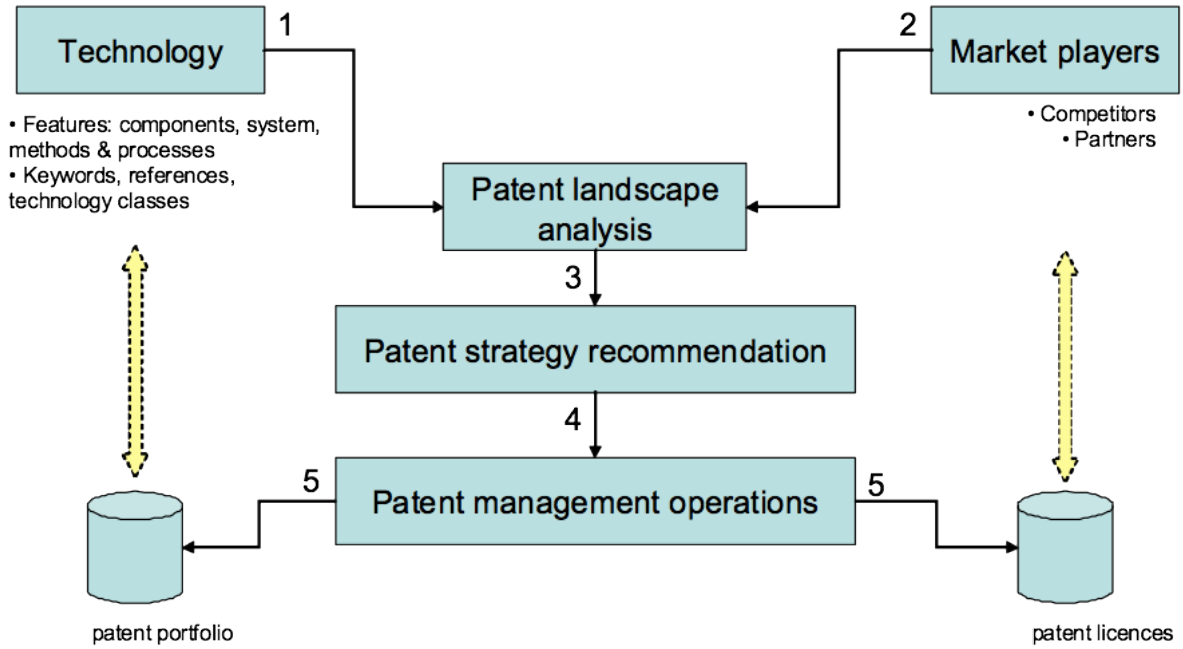

Figure 5. The IPStudies methodology for patent portfolio strategic management.

A simple approach is described below and graphically shown in **Figure 5**:

1. **Identification of the technological target - in collaboration with R&D**
   a. Characterization of the developed technology: building components, assembly of those components within a system (architecture), specific methods and processes, supported functionalities.
   b. Identification of keywords, literature citations outside of patents (including known experts in the field, norms and standards), technological classes, useful for research within the patent databases.
2. **Identification of competitors and partners - in collaboration with sales and marketing teams**
   a. Identification of known competitors.
   b. Identification of needed partners for the final product deployment.
3. **Analysis of the patent landscape**
   a. Identification of the patents in the portfolio applicable to the development of the product[5].
   b. Identification of new filing opportunities.

[5] This identification is implicitly done in a small to mid-size company with a portfolio of a few dozen patents at most. However, beyond a hundred patents, a more formal identification is indispensable, especially when several subsidiaries of a multinational company are involved.

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c. Research within the patent databases, based on the data collected during steps 1 and 2.

d. Determination of the R&D development positioning in the current patent landscape.

Depending on the technology development stage and depending on the internal knowledge of the targeted technological field, notably regarding competitive environment and substitutive technologies, the positioning within the "patent landscape" will be analyzed qualitatively (consideration of competition information that wasn't formalized internally, for instance in the case of patent and competition monitoring), and/or quantitatively (measure of patent indicators such as applicants' historical evolution, or forward citations to the analyzed patents).

4. Recommendation - dedicated patent strategy

a. Definition of the optimal positioning for the target product in the patent landscape.

b. Recommendations for the development of the patent portfolio or licensing agreements in order to reach optimal positioning.

Depending on the "patent landscape", recommendations concerning the optimization of patent management linked to the technology analyzed can then be offered:

- Incentives for new developments leading to complementary filings aiming to better capture the company's innovations and preserve a high added value, in particular in response to the arrival of substitutive technologies;
- Negotiation of licensing agreements aiming to better control commercial and legal risks;
- Incentives to optimize the existing patent portfolio investments (in particular the functional and geographical coverage, when still open in the prosecution process) and revenue (licensing, divestment) with regards to the competition.

5. Operationalization

Execution of the patent portfolio prosecution and licensing agreements according to the recommendations defined in step 4.

The systematic, formal positioning of each newly developed technology in its competitive environment in terms of "patent landscape" allows to best direct the "operations and tactics" for the management of the associated patents and better control the corresponding budgets: filing decisions, extensions, maintenance and licensing sales/purchases.

The patent manager, a developing multidisciplinary profession in the technology company

These patent analysis activities should therefore be part of the routine services offered by a patent management office within the company, while allowing to benchmark an activity that until now was difficult to formalize and evaluate. In particular, with the development of the importance of intangible assets in the company valuation/development, any patent manager, and of course the director of intellectual property, have to weigh in more and more in inter-disciplinary workgroups including the heads of product lines and strategic planning.

Beyond the analytical competencies, the technical understanding and the legal knowledge necessary to their craft, they now need to develop a wider view of the technological and legal positioning of the patent portfolios they are responsible for within wider and multifaceted competitive environments, in which technological development is done as much by internal R&D, academic and/or international collaboration projects, as by merger-acquisition operations.

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Application to financial analysis and reporting

Listed companies indices, patent exchange et patent investment funds

The use of patent indicators is still under-developed in the context of financial analysis. The most publicized approach is presently Ocean Tomo's, an American company who introduced in 2007 its Ocean Tomo 300® of the 300 most innovative companies, using their patent-based metrics. Ocean Tomo shows on its website that its index outperforms the S&P®500 over the last three years, as well as the Russell 100 index from 1997 to 2007 for the 60 best-performing companies according to its patent-based metric [OceanTomo].

Ocean Tomo is also part of the launch of a patent exchange, l'IXPI, planned for 2011. The IXPI is now (Spring 2011) searching, in Chicago, for analysts able to evaluate the technological assets of a company, as well as its patent portfolio, to establish a patent landscape and to put this data in perspective with various financial performance and market evolution factors measured using conventional methods [IXPI].

In Europe, very little attention has so far been brought to the technological assets and consequently to the patents when evaluating a company. This is explained by national legal specificities, since counterfeiting lawsuits cannot be brought at the European level for patent infringement, as well as by the lower damage awards compared to the United States (possible tripling there in case of voluntary offense). The launch by Deutsche Bank in 2007 of patent portfolios investment funds has raised interest (and 150M Euros), but the bankruptcy in 2010 of the company managing those funds, IP Bewertung, created a negative precedent as far as the direct monetization of patent portfolios is concerned [IAMWild].

Venture capital and valuation towards IPO

Upstream of the technological growth markets, in the field of venture capital, intellectual property audits during due diligence are still often entrusted to the firm in charge of the audited company's patent portfolio management, for practical reasons but also to limit costs (the firm already has all the necessary files), in spite of the risks of conflict of interest that can overvalue the legal quality of the patents.

In other cases, the valuation is entrusted to financial experts devoid of legal knowledge in the patent field in order to determine the value of a patent or a license, sometimes as part of a financial package including the activation of the license according to the IFRS or GAAP rules. The value is then calculated from market information, assuming licensing exclusivity… without verifying its legal validity. Yet if there isn't, beyond formalized patents, a significant secret know-how (usually measured on the one hand by the scientific and technical quality of the teams, on the other hand by the quality, originality and technical difficulty to counterfeit the commercialized products), this valuation has value only in the very short term ("technological value" stock attractiveness in fashionable fields such as cleantech and biotech).

Clearly, if a rough valuation is enough to develop an argument for "sell-side" patent valorization, a finer analysis is highly recommended on the "buy-side", especially for investments aiming for asset safety and mid- to long-term performance.

Loan collaterals

More and more in the past few years, intellectual property portfolios (patents, but also trademarks, for instance in the case of Toys'R'Us) are being used as collateral for the banks lending to companies. The patents used as collateral can be identified from the US Patent Office (USPTO), whose databases usually register the bank as co-owner of the patents in those cases. Those collaterals usually span the full portfolio, and it can be interesting to correlate them with other information available about publicly traded companies to estimate the value of the company's intangible assets.

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Financial reporting

The WIPO encourages small and mid-size companies with high technological value added to supplement their institutional communication (annual report, financial reports) with an intellectual property report in order to improve their image, reputation and value on the market. The IFRS and GAAP accounting rules are indeed based mainly on the valuation of the past and of tangible assets[6], so financial reports don't reflect the value that a good intellectual property strategy creates over the mid- to long-term, even though this is obviously essential information for investors, even more so since the economy is evolving more and more toward a knowledge economy.

When it isn't possible to get an intellectual property report from the company, (the different specialties within the company have to prepare for it, as outlined earlier) an external analysis can easily derive extremely precise information from the analysis of the patent databases, on the structure, durability and intensity of the R&D activity by, for instance, studying the number, the productivity and the geographical repartition of the inventors, the existence of co-inventions with third parties (small to mid-size companies, universities, etc.), the frequency of technology transfers (patent purchases), etc. This data, publicly available but as of yet under-used because little known, usually provide a complementary perspective to the company's communication via its annual report and its investor conferences, in particular for a predominantly technological company - Apple's Californian fans have well understood this, to the point where they widely exchange via their social networks any and all discovery and opinion regarding all unexpected patent filing by their favorite company..

Practical use

The field is still too recent to have established universally recognized metrics for patent evaluation and their correlation with the company financial value, beyond first efforts in this direction by the likes of Ocean Tomo. However, it is already possible to verify using online patent databases several simple indicators such as size, functional, legal and geographic coverage and the impact (citations, oppositions) of a company's patents.

It is also interesting to refine the analysis in a more qualitative way by comparing the patent database data with other available data, such as product functionalities and R&D investments according to the company's documentation as well as institutional company communication. For small patent portfolios (a dozen patent families), a complete valuation can be performed with the help of a patent valuation expert. [Cromley2004] describes a methodology example applicable to the case of American patents.

It is often possible to verify through patent analysis how the strategic orientation of a technological company evolves in its R&D, and to determine to which extent it acquires differentiating innovations, guarantors of the mid- to long-term durability of its technological value added, hence its profitability, beyond leaders promises and emotional market expectations. In particular, in the case of disruptive innovations, it is possible to identify the re-orientation of the company or certain product lines before institutional communication officially announces them, and thus to anticipate the evolution of market positioning over the mid- and long-term.

[6] The introduction a few years ago of Rules FAS141 and FAS142 in the American GAAP standard and of Rule IFRS/IAS38 internationally improves the accounting of intellectual property. However, given their definition, it's mainly during merger-acquisitions that the latter is actually valued in the assets.

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Conclusions

The analysis of data about companies patents has been growing for several years in parallel with the knowledge economy, and is poised to be now used in professions until now relatively far from intellectual property, such as marketing, strategic planning, and even financial analysis.

Within a company, while the use of market studies and financial databases has become so common that it is no longer truly differentiating, the integration of patent data which are available ahead of the technological products lifecycles is now a way to anticipate the competition, at least for the companies active in high value added technological fields, and to adapt one's tactical response ahead of phase of the evolution of one's markets (notably in the case of the emergence of substitutive technologies). The use of patent data, indicator synthesis and patent landscape analysis at the service of the decision makers will most likely grow in the next few years, in the wake of the large companies' emerging practices, and it is important that for the affected professions to prepare themselves for it now.

In parallel, economists have been developing for several years patent analysis models to specifically study the value of a company. These approaches, confidential as of yet, are bound to be developed further in a world where 70% to 85% of a company's stock value is now attributable to their intangible assets, patents being a large part of them in technology companies, and where many investors, both institutional and individual, made wary by the financial crisis, are looking for new indicators allowing them to better evaluate the profitability potential of their investment over the mid- to long-term, beyond the short- to mid-term speculative approaches. From this point of view, the emergence of reference indices regarding patent portfolio quality for publicly traded companies such as those proposed by Ocean Tomo in the United States foreshadow a fundamental trend corresponding to the need to better evaluate the quality and the impact of those intangible assets, whose importance keeps growing. It is likely that the number of such indices will grow exponentially over the next few years.

Intellectual property still remains a complex field reserved to specialists who have a double technical and legal training. However, the continuing education offering keeps becoming larger in the fields of licensing, technology transfers and patent evaluation, in phase with market needs. In France, IEEPI has been offering since 2006 several courses, with the support of the State and trade organizations such as LES (Licensing Executive Society), to specifically address the economic and strategic aspects of intellectual property while benefiting from the supervision of experienced practitioners from various areas. In the United States, the Business Development Academy launched in 2010 a certification program for patent evaluation analysts, sponsored by various American industry experts and practitioners, and has already trained in one year several hundreds analysts in the United States, Europe and Asia. In a second phase, post-graduate management institutions, in particular technology management MBAs, should also present those aspects more in depth in their programs within the next few years.

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Glossary

Backward citation:	Reference **to** a formerly filed patent application by a given patent application. Those quotes are explicitly listed in the header of published US patent texts. For European patents, they are primarily found in the patent office examination search report
EPO :	European patent office.
Forward citation :	Reference **by** a later filed patent application to a given patent application. Search for forward citations is generally offered by patent databases user interfaces, such as the free access USPTO online database, as well as in a number of commercial patent search tools.
IPC :	International patent classification
NPE :	Non Practicing Entity – a for-profit company whose business model consists in monetizing intellectual property rights without exploiting them on its own in manufacturing, distributing or selling related products or services. A.k.a. troll.
Patent family :	The set of national and international patents derived from a given patent application initially filed in a given country.
PCT :	(International) Patent Cooperation Treaty.
PLC :	Product Life Cycle.
Troll :	see NPE.
USPTO:	United States Patent & Trademark Office.
WIPO :	World Intellectual Property Organization.

About

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Corinne Le Buhan holds a MSc. in electrical engineering from the National Institute of Applied Sciences (INSA) in Rennes, a PhD in communication systems from the Swiss Federal Institute of Technology (EPFL) in Lausanne, and a post-graduate university degree with honors in strategic management of intellectual property and innovation from the university of Economics in Strasbourg and IEEPI.

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Corinne Le Buhan is the author/co-author of 18 scientific and technical publications, and 14 patent applications, most of which have been extended internationally. She is a member of the Licensing Executive Society, IEEE, AROPI and AAIEEPI.

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