Patent portfolios of European wind industry: New insights using citation categories

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A B S T R A C T

This study explores the use of citation categories assigned by patent examiners to study overlap of patent portfolios among top wind power firms. Cooperative Patent Classification (CPC) is used to obtain a sample of wind industry patents. CPC is shown to be better than the International Patent Classification for identifying patents relevant to the wind power industry. Results show high inter-firm citation among the top wind industry players that can suggest concentration of innovation. The results can be useful for patent analysts, technology managers and policy makers.

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1. Introduction

A patent contract requires inventors to disclose their inventions to the public, in return for protection against their unsolicited use. The incentive for inventors is the temporary monopoly for the use of their invention. The public, on the other hand, gets to see how the invention works and have a chance of improving it. The details of the disclosure of inventions are stored systematically in worldwide patent databases. In addition to the full text, claims, inventor/applicant information of the inventions, data on technical classifications and citations added by examiners are also available in patent databases. This data has given rise to the field of patent statistics that can be used to predict the scientific and technological activities of firms, industries and nations.

Patent data has been used for various purposes, such as competitor monitoring [1], patent quality assessment [2,3], scanning potential co-operators or acquisition targets [4,5], technology lifecycle forecasting [6,7], and so on. As a field, patent statistics has grown briskly in line with a rapid increase of patents filed worldwide and the availability of improved patent databases. Researchers have produced a myriad of patent value indicators to determine the value potential of patents.

Of the many patent value indicators, citation-based indicators are the most common among researchers. Patent citations are used because the value of patent counts is severely limited by the large variance in the significance of individual patents. References made to previous patents are called backward citations, and references received from future patents are called forward citations. Cumulative and knowledge transfer indicators use backward citations, and impact-type indicators are based on forward citations [e.g. [8]]. The advantages and disadvantages of using patent citations are extensively discussed in Ref. [2]. For example, a long accumulation process of forward citations restricts their use in the evaluation of very recent innovations. Studies [3,9] have also shown that there is a lack of consistency in results based on citation analysis due to the idiosyncrasies of various patent offices worldwide. Using backward citations as a value determinant has provided ambiguous results [10,11]. One limitation related to citation analysis has been that citation counts have been considered rather than the nature of citations. This has led the authors to believe that there is some scope in refining citation-based indicators and the insights that can be obtained from them.

A worldwide increase in patent filings has also been characterized by marginal inventions with broad and/or overlapping claims. Building patent fences and blocking competitors are some of the new strategic motives of patenting [12]. In light of these trends, the nature of citations accumulated by the European Patent Office (EPO) examiners can offer insights into studying trends related to overlapping and blocking. This paper uses the citation categories formed by the EPO examiners to weigh the relevance of citations made in patent search reports. The value weighing of citations can lead to more refined usage of patent citations in determining the

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value potential of patent portfolios. The analysis is based on the proposition that the portfolios of patents that receive a larger share of 'X' and 'Y' citations from other patents are more valuable than others [13].

The contribution of the paper is two-fold. The research first explores the use of Co-operative Patent Classification (CPC) in analyzing wind power patents in Europe and other countries. The results show that better sampling can be done using the CPC than the International Patent Classification (IPC), especially for US patents in the wind industry. Secondly, two measures are introduced, the measure of encroachment and the measure of hindrance. These measures use citation categories to study the overlap in the patent portfolios of the top players in the European wind industry. The results indicate high inter-firm citing among the top players.

The research on citation categories is exploratory, and the case study approach is used to obtain the results. The developed indexes are used in evaluating the competitive landscape of the European wind power industry. Currently, wind power technology is one of the fastest growing renewable energy technologies, and it has been intensively studied from the policy perspective [14,15], technological perspective [16,17] and combinations of these [18]. The key drivers for the growth of the wind energy market are the increasing global demand for energy, environmental concerns due to climate change, and economic considerations, as the cost of energy (CoE) generation by wind power can be predicted quite well. However, wind power is still in the accelerating stage of its lifecycle [19,7] and requires various support schemes in order to be competitive among the alternative energy sources [20]. Since the beginning of this century, we have seen that the patenting activity within this particular technology has drastically increased [e.g. [21]]. In patent–based studies, retrieval of wind industry patents has been typically based on the International Patent Classification (IPC) code 'F03D', which stands for 'wind motors' [22,23,18]. Dubaric et al. [7] have utilized the European Classification (ECLA), which is based on IPC but has an additional 66,000 subdivisions, being thus more precise and systematic. With the help of ECLA, the present authors were able to analyze systematically the lifecycle of sub-technologies like regulation, rotor form and pitch adjusting. A recent study reported that there are significant differences between volumes of patenting in the wind industry against the quality of these applications. This could lead to increased cost of litigation in the future [24]. The study further goes on to indicate that there could be a greater concentration of patents among the bigger players with litigation costs expected to escalate to $1 billion by 2020. In light of these trends, intellectual property will become even more valuable in the wind industry, which can generate interest among the stakeholders.

Section 2 sheds light on the theory of patent classification and citations. Section 3 introduces the data and empirical analysis based on sampling of wind industry patents. This is followed by the methodology of using citation categories to build a measure of hindrance and a measure of encroachment. Section 4 presents the results of the citation category analysis. Discussions and conclusions follow in Section 5.

2. Theory of patent citations and classification

2.1. Patent citation analysis

The history of citations in patents dates back to 1947 when examiners in United States Patent and Trademarks Office (USPTO) began citing the references considered during the examination process [25]. Forward citations can be used to assess the technological impact of innovations and thus the economic importance of patents. In the measurement of patent quality [26,27,3], citations

received have been used as a proxy of the impact of technology. Backward citation analysis can potentially provide insights into the exploration process of new technologies or radical search behavior [28,29]. The idea behind utilizing backward citations as a value determinant is in the assumption that combinations and knowledge transfer from other technological domains would lead to more valuable patents [30]. Studies have combined forward and backward citations with the technical classification of patents to obtain measures of the originality and generality of patents [31,10]. In Europe, applicants are not obliged to add references to their patent applications. The patent examiners are primarily in charge of adding technical classification and citations.

2.1.1. Citation categories

The presented analysis makes use of the citation categories that are assigned to patent references by the examiners of the European Patent Office (EPO). The EPO examination guidelines [32] require all documents cited in the search report to be identified by a certain letter or a combination of letters where appropriate. The search report is made public by the EPO examiners with the publication after 18 months of the patent filing. After a patent is filed and all the administrative formalities are complete, the first step for the patent examiner is to judge the novelty and inventive step of the invention. This is done by a prior art search, and the relevant references are cited in the search report. Each reference that is cited in the search report is assigned a citation category. Citation categories are a useful way of assigning relevance to a cited document in terms of its impact on the claims of the patent application.

Two main citation categories are considered in this research, X and Y. Documents marked 'X' in search report references indicate a clear similarity between the claimed invention and the contents of the cited document. 'Y' refers to documents that can be combined with other documents by a skilled person to develop a concept similar to the claimed invention. Documents ascribed 'A' refer to records which define the state of the art, but no aspect of the document can challenge the inventiveness of the claimed invention. Table 1 includes the definitions of less used citation categories, as well as the main categories X, Y and A.

The search report is prepared by the examiner to make the applicant aware of the chances of a successful patent grant. Knowledge of search reports is a pre-requisite for carrying out citation analysis. Michel and Bettels [33] present some intricacies of citation categories and other factors related to the heterogeneity of

Table 1
Description of commonly used citation categories [8].

Citation category	Description
X	Particularly relevant documents when taken alone (a claimed invention cannot be considered novel or cannot be considered to involve an inventive step)
Y	Particularly relevant if combined with another document of the same category
A	Documents defining the general state of the art
O	Documents referring to non-written disclosure
P	Intermediate documents (documents published between the date of filing and the priority date)
T	Documents relating to theory or principle underlying the invention (documents which were published after the filing date and are not in conflict with the application, but were cited for a better understanding of the invention)
E	Potentially conflicting patent documents, published on or after the filing date of the underlying invention
D	Document already cited in the application (provided by the applicant)
L	Document cited for other reasons (e.g. a document which may cast doubt on a priority claim)