Social network analysis of patent infringement lawsuits

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ABSTRACT

Using patent lawsuit information, we develop a method to identify companies with a significant legal influence on the technologies used in their industry. We construct a patent-infringement lawsuits graph, using the data from intellectual property lawsuits between companies, and analyse the level of influence of companies by computing the network centrality of each company in the graph. To illustrate the practicality of our method, we apply the proposed method to analyse the patent influence of well-known companies in the smartphone industry. The results of our empirical analysis are well matched to the current smartphone market status — for example, Apple, Nokia and Samsung are identified as the most important companies, which lead the smartphone technology and market. This shows that the proposed approach can be used to evaluate and manage patent portfolios even using a relatively small amount of patent lawsuits data.

1. Introduction

With the introduction of Apple's iPhone and its rivals including Google's Android, the mobile phone industry has emerged as an exciting and fast-changing field. Unlike previous smartphones, the latest smartphones, including the iPhone, enable an intuitive and rich user experiences; they are attractive to a wide range of users, not only tech-savvy but also casual users. As a result, the market for smartphones has started to grow dramatically. Nowadays more than 1.3 billion mobile phone handsets are sold annually, and smartphones made up almost 20% of that total in 2010. Sales of smartphones are doubling every year, and the total global sales volume is expected to surpass that of PCs by 2012 [1].

The explosion of the smartphone market has triggered strong competition among mobile phone manufacturers. For such companies, a common strategy is often to sue their competitors as this can damage competitors' credit or extract licence revenue out of the accused infringers. There are currently more than 50 patent-infringement lawsuits relating to smartphone technology. In October 2009, Nokia sued Apple for patent-infringement and twenty months later Apple agreed to pay Nokia patent licence fees. In addition, Apple sued HTC in March 2010 and then HTC counter sued Apple in May 2011, and Samsung and Apple also sued each other for patent-infringement around the world. In short, it appears that a sued company will try to defend its patent rights through a counterclaim. This is nothing new; the military strategist Carl von Clausewitz said 'the best defense is a good offense' [2]. This study is partly motivated by these recent patent-infringement cases.

This paper explores the usefulness of patent-infringement lawsuits as a measure of the *valuation* of a firm's patents. Since patents are assets to companies and considered as an evaluation factor for the value of firms, many prior research studies have been focused on evaluating the quantity and quality of patents that a company is holding to provide various information such as patent portfolio and valuation of the company to the market. However, because of security reasons, the existing studies using patents themselves often limit to access the data associated with patents and, therefore, are not practical in many cases.

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On the other hand, information of patent-infringement lawsuits is easy to access and reflects the importance of patents well even with a small number of cases. Thus we propose a methodology that collects data from intellectual-property lawsuits in order to identify relationships between companies within the same industry and then to automate the extraction of useful characteristics of the companies from the relationships. The method can identify the roles or the relative positions of companies in the patent landscape of an industry such as the mobile phone industry. We make the following two contributions, inspired by recent advances in complex network analysis:

1. We propose a method to analyse the patent-infringement lawsuits between companies within the same industry. We construct a patent-infringement lawsuits graph from the collected patent-infringement cases, and analyse the topological positions of the companies. The most important and practical application is to measure the influence of each company in the patent-infringement lawsuits. Unlike the existing solutions [3–7] focusing on patent citation information, the proposed method uses the patent-infringement lawsuits. In many cases, the proposed method can have a key advantage over the citation patent analysis since it requires only the small number of patent litigation cases rather than tracing all the relationships between citing and cited patents which eventually lead to a citation network consisting of a large number of nodes and edges. We particularly suggest the use of the two network centrality measures (degree and eigenvector centrality) to measure each company's topological importance in the constructed patent-infringement lawsuits graph. The computed network centrality measures can be used as guidelines or reference points to help identify the roles of companies by categorising companies into four groups (see Section 2).

2. In order to show the feasibility of our method, we apply the method to analyse the recent patent-infringement lawsuits between companies in the mobile phone industry. We collect the patent-infringement cases from January 2006 to August 2011 involving 26 well-known companies in the mobile phone industry, and quantitatively measure the relative importance of each company in the patent-infringement lawsuits. According to the analysis, Apple, Nokia and Samsung can be classified as companies leading the smartphone market with their high value patents while HTC, LG, Motorola, RIM and Sony Ericsson are considered as companies that have relatively weak patent portfolios, therefore often been sued by other companies. In addition, Gemalto, InterDigital, Kodak, Microsoft, Mosaid, Qualcomm and Smartphone Technologies LLC are classified as companies that tend to sue other competitors for patent-infringement without serious threats of patent "counter-suits" by others.

The rest of the paper is organised as follows: In Section 2, we discuss some related work on patent analysis. In Section 3, we describe how to construct patent-infringement lawsuits graph from the patent-infringement cases, and the constructed graph is analysed. In Section 4, we apply the proposed method to analyse the recent patent-infringement lawsuits between representative manufacturers in the mobile phone industry. In Section 5, we discuss potential applications of the proposed method. Finally, the paper finishes with conclusions by summarising the contributions of this work and future directions in Section 6.

2. Related work

Patent analysis is in widespread use today due to the proliferation of patent related databases. The aim of this analysis is to use patent data (e.g., number of patents, application year, registration country and citation information) to derive information about a particular industry or technology used in forecasting. Because of this, patent analysis has been shown to be valuable in planning technology development. For example, [8] used patents for trend analysis by applying text-mining and data-mining techniques; [9] additionally applied network analysis to focus on conducting the analysis of patent claims; [10] used patent analysis techniques to forecast emerging technologies; [11] provided a patent-based cross impact analysis method to estimate technological impacts quantitatively; [12] identified clusters of patents by analysing similar content/structure and [13] evaluated the risk of patent infringement. Recently, [14] proposed an empirical method that relates companies' market return to information about patent citation patterns to infer innovation market competition. A study about the mobile phone industry by [15] is more highly related to our research interest than others. They illustrated how several mobile telecommunications firms (Sony-Ericsson, Nokia and Samsung) pursued patent strategies to catch up with the market leader (Motorola) through intensive analysis of the patents of the four mobile manufactures.

In order to measure technological performance, inventive performance, and/or innovative performance several patent-based indicators have been introduced. The most widely used indicator is to simply count the number of raw patents. Although raw patent counts are subject to the criticism that this naive indicator does not take into account the relatively different weights of patents [16,17], this indicator is generally accepted as one of the most appropriate indicators to evaluate the inventive or innovative performance of companies in terms of a particular technology and industry [18–23]. A more sophisticated indicator is to use patent citations [24–26]. Compared to raw counts of patents, which evaluate a purely quantitative measure, patent citations can be used to measure the qualities of patents. The basic assumption is that the number of patent citations for a particular patent indicates its importance or impact, and therefore the use of patent citations also has limitations [27]. Particularly [28] found the problem called "home bias effect" in patent citations. However, at the macroscopic level, the use of patent citations can be enough to measure the importance of patents. Recently, [29] proposed a stochastic approach to assess future technological impacts of patents over time. [30–33] have shown the validity of patent citations as an indicator of the quality of inventions or innovations by analysing the correlation between the importance of patents (evaluated by experts) and the number of citations.

One alternative approach to focus on the relationships between patents is citation networks. A citation network consists of a set of nodes representing patents and a set of edges, where an edge from node *x* to node *y* represents a citation from patent *x* to