Chapter 3
Evaluation of Technological Influence Power of Enterprises through the Enterprise Citation Network

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ABSTRACT

As an important source for discovering new competitive technological intelligence involved in enterprises, patents can be analyzed to identify the technological strategy and the potential competitors. Based on the patent citation information, the weighted and directed enterprise citation network is established. Based on the modified PageRank algorithm, a novel method is provided to evaluate the technological influence power of enterprises. Experiments with this method have been done using the patent dataset in the field of fluid-pressure and analogous brake systems during the 25-year period from 1975 to 1999 from the United States Patent and Trademark Office. Compared with the traditional assessment indicator based on the citation count method, the proposed method is more reasonable in identifying the technological influential enterprises, as it gives a comprehensive consideration of the amount of citing enterprises, the influence of citing enterprises and the citation strength between them. This study helps enterprises discover potential technological competitors, which take the lead in the industry.
1. INTRODUCTION

In the era of globalization and knowledge-based economy, the competition between enterprises has shifted from product manufacturing to innovative creation. Technological innovation strategy has been thought to be the key to the development of enterprises. When making the innovation strategy, the primary task is to discover the technologically influential enterprises in the industry, which is an important support for enterprises to identify their actual and potential competitors and make an effective innovation strategic deployment (Zvi, 1990; Narin et al., 1987).

Patents, as the core of the product and process of technological innovation, contain more than 90% of the latest technical information in the world (Breitzman & Mogee, 2002). With the fairly large scale, extensive new contents, complete descriptions and the precise classification, patents become the unique source for discovering new technological information and competitive intelligence (Van Looy & Callaert, 2003).

For patents, the citation information can be viewed as the recommendation or endorsement of the later inventors (Gress, 2009). The number of citations can reflect the innovation level of the patent and its contribution to the progress of the industry (Michel & Bernd, 2001). When the citing enterprise makes an attempt to get authorization from the cited enterprise, the cited enterprise can take the initiative in the cross-licensing negotiations with it. Therefore, if an enterprise holds many important patents which are cited by many other corporations, it will have a great technological influence power and a great competitive advantage in the market competition.

In order to discover these technologically influential enterprises, more and more research has been concerned with the use of the patent citation information. Kinds of related models and indicators for evaluating the technological influence power of enterprises have been proposed by analyzing how many times an enterprise has been cited, such as Citation Index, Current Impact Index, and Total Technological Strength, etc (Schmoch et al., 1994; Karki, 1997).

Although the number of citations is kind of an approximation of the technological competence of enterprises, it could only reflect the technological influence power of enterprises in a limited way. In those studies, the citation from authoritative enterprises or from unimportant enterprises in the industry is treated equally, and the citing strength of different enterprises is ignored. This motivates us to study a new effective indicator instead of citation count method for ranking the candidate enterprises. The similar problem has been solved by the Google PageRank algorithm in Web structure mining (Brin & Page, 1998) or the other algorithms on the social networks (Bonacich, 1972) and information networks (Kleinberg, 1999).

In the study, we establish an enterprise network based on the patent citation information where both weight and direction information of links are concerned, which correspond to the strength of citation relations and the citation direction from one enterprise to another one, respectively. Based on the weighted and directed enterprise network above, a new algorithm coming from the main idea of the Google PageRank algorithm is put forward to evaluate the technological influence power of enterprises in terms of the number of citing enterprises, the importance of the citing enterprises and the citation strength between enterprises. Experiments with such method have been done by using the patent dataset in the field of fluid-pressure and analogous brake systems during the 25-year period from 1975 to 1999 from United States Patent and Trademark Office. The experimental results have verified the effectiveness of the proposed evaluation method.
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