Evaluation of Enterprise Technology Competitiveness

Based on Technology Topics

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Technology competitiveness is the material foundation of the company core competitiveness. As a result, the evaluation of technology competitiveness is crucial to formulating R&D strategies of the company. In previous studies, scholars have applied the patent IPC and Derwent classification codes for research(Narin et al., 1987).Their researches on the evaluation of technology competitiveness mainly include index system evaluation method, patent portfolio analysis method, patent network and matrix evaluation method, etc.

With the rapid development of technology, traditional topic classifications are too general, short of timeliness and scientific. As a result, relevant frontier areas and key technologies cannot be meticulously represented. Therefore, this paper uses the LDA topic model to extract the technology topics of the patent texts,and improves the patent portfolio evaluation index. This method not only avoids the disadvantages of the traditional topic classification method, but also comprehensively considers the correlations between technology topics and time factor in the evaluation.

The evaluation method of enterprise technology competitiveness constructed in this paper mainly includes three steps:

The first step, LDA topic model is adapted to identify technology topics of patent texts.(Heinrich, 2008).

The second step, from the company level, a technology competitiveness measurement model is constructed based on the technological coverage index(Chiu et al., 2008), technological specialization index(Abramo et al., 2014), and technological activity index. The specific formulas are as follows：

(1) Technological coverage index

Technological coverage represents the breadth of the technology topics covered by the company's patents. The formula is shown in (1).

$$TC = 1 - \sum_{i=1}^{n} \left(\frac{f_i}{f} \right)^2 \quad (1)$$

where n represents the total number of technology topics, f_i represents the weighted amount of patents containing subject category i in the company, f represents the total number of patents in the company. The larger the value TC, the more diversified the company's technology fields and the wider coverage of technology topics.

(2) Technological specialization index

Technological specialization refers to the degree of centralization of technology topics that the company owns for patents. The formula is shown in (2).

$$TS = \frac{\sum(f_i \times f_j \times \cos(t_i \times t_j))}{\sum(f_i \times f_j)} \tag{2}$$

where t_i and t_j indicates that the patents relate to the category of the topic, $\cos(t_i \times t_j)$ indicates the degree of association between the category t_i and the category t_j. The larger the value TS, the stronger the professionalism, and the company occupies more advantages in technology competition.

(3) Technological activity index

Technological activity refers to the speed at which companies introduce new products and technologies. In order to fully reflect the changes in the time and quantity of patent applications, the formula uses the quantity of patents of the company over the past five years. The formula is shown in (3).

$$TA = \frac{f_5}{\overline{F_5}} \tag{3}$$

where f_5 indicates the number of patent applications of the company in the past 5 years, and $\overline{F_5}$ indicates the average number of patent applications of all companies in the past five years. The higher the value TA, the better the company's technological development and the more patents issued in the past five years.

The third step, an effective rule for evaluating the enterprise technology competitiveness is constructed: a bubble chart is constructed in which TA as the abscissa, TC as the ordinate, and TS as the point. From the bubble chart, we can comprehensively evaluate the type of company, the level of technological activity, and the strength of technology.

The specific technological framework is shown in Figure 1.

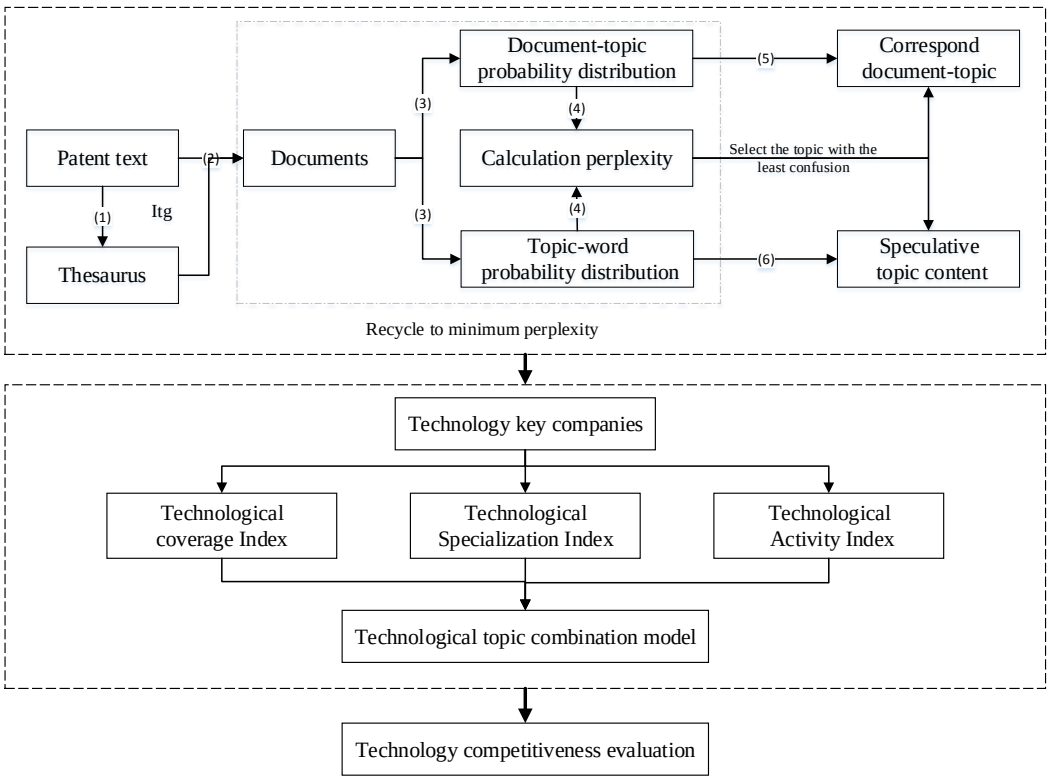

Figure 1 The framework for evaluating the enterprise technology competitiveness

3D printing technology is taken as a practical application in this paper. The radar chart (Figure 2) can analyze the development of the company's various technology topics as a whole, which based on the weight relationship between the company and the topics generated by the LDA topic model. Further, we can understand the company's key development of technology topics. We draw a bubble chart by calculating the various indicators. This paper focuses on analyzing the positions of companies in bubble charts. The first quadrant is active integrated companies, with the technically-oriented leaders at the quadrant. The second quadrant is inactive integrated companies, and most of them are large-scale companies with backward technologies. It is a large company with backward technology. The third quadrant is inactive single companies, and most of the them are emerging companies. The fourth quadrant is active single companies, and most of them are potential technology-focused companies.The quadrant and bubble size determine the overall competition of the company and define the company's technological competitive position. In addition, the research results can provide a reference for identifying the company's competitors and determining the company's R&D strategies.The research of this paper also hopes to provide reference for the research methods of enterprise technology competitiveness.

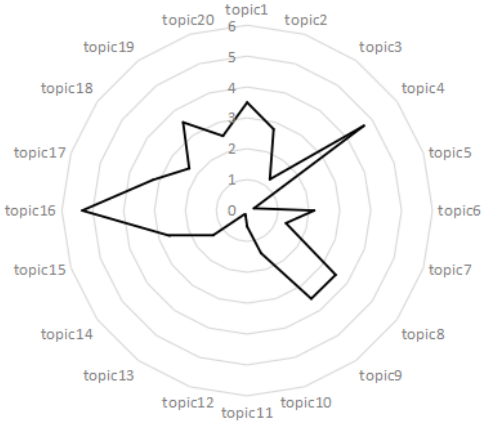

Figure 2 The radar chart of technology topics

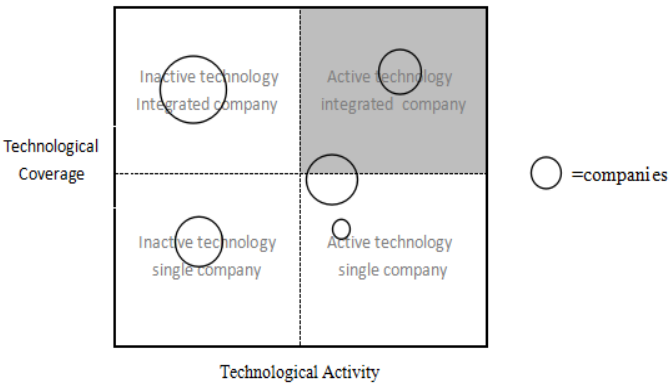

Figure 3 The bubble chart of evaluation

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