An Empirical Test of the Evaluation Model on Core Patent Documents

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Introduction

The patent document becomes an important information source for technology assessment and forecasting. In our previous study, combining AHP and Delphi Questionnaires as the primary approach, with a group decision-making model basing on the Maximum Likelihood and Unbiased Estimation theory, we constructed an evaluation model for identifying core patent documents of a certain technology field in patent information analysis (Zhang, 2009a). This paper is a subsequent practical application of above evaluation model developed in our first-stage study. An empirical test is carried out. The evaluation model is applied to calculate the value score of patent documents in a certain field. Those patent documents that have the highest scores are selected as the core ones in their field. By peer review, these documents are recognized as the core patents. Empirical test results turn out that this model works well. This paper reports the results of the empirical test on this issue. The focus is to look at the empirical process.

Methodology

Indicator system optimization

The further clarifying of relevant indicators in our previous evaluating system is the starting point for our empirical issues. Reviewing the system, we optimize 3 indicators which did not reflect practice, to further optimize the evaluation performance. The 3 indicators are Technology Dependence (TD), Science Linkage (SL) and Standardization Index (STI). After these adjustments, the evaluation hierarchical structure with weights is further optimized to practical empirical.

Valuing rules of each indicator

The valuing rules of each base-level indicator of the evaluation system are determined. That is how to assign to each indicator. Multiple data sources are employed in our empirical test for the availability of indicator measurements, including: Derwent Innovation Index (DII), Aureka and Journal Citation Reports® (JCR) from Thomson Reuters; Patent Full-Text and Image Database (PatFT), Patent Application Full-Text and Image Database (AppFT), Patent Application Information Retrieval (PAIR) system and Patent Assignment Database (Assignments on the Web) from USPTO; Industrial Property Digital Library (IPDL) from Japanese patent office.

Normalizing and dimensionless

To eliminate computational problems caused by differing measurement units, it is essential to normalize attribute ratings in empirical application. Normalization aims at obtaining comparable scales, which allow inter-attribute as well as intra-attribute comparisons. Consequently, normalized ratings have dimensionless units (Yoon, 2005).

Firstly, we classify the attributes of the system into two groups, and then for each group, present normalization techniques. (1) Benefit attributes: Offer increasing monotonic utility. That is, the greater the attribute value the more its preference; (2) Cost attributes: Offer decreasing monotonic utility. That is, the greater the attribute value the less its preference.

The principle of our normalization is to transform the attributes so that all the attribute values mapped into the range [0, 1]. Here Linear Normalization method is adopted as following:

For the jth attribute p_j, its value $x_{ij} \in [v_j, V_j]$, where v_j is the minimum value of p_j while V_j is the maximum value of p_j.

For benefit attributes, the normalized value of xij is given as

$$r_{ij} = \frac{x_{ij} - v_j}{V_j - v_j} \quad (i = 1,2,\cdots,m;\ j = 1,2,\cdots,n) \qquad (1)$$

While for cost attributes, the normalized value of x_{ij} is given as

$$r_{ij} = \frac{V_j - x_{ij}}{V_j - v_j} \quad (i = 1,2,\cdots,m;\ j = 1,2,\cdots,n) \qquad (2)$$

It is clear that $0 \le r_{ij} \le 1$, and the attribute is more favorable as r_{ij} approaches 1.

Empirical test

Implementation procedure

The empirical test is implemented by the following steps:

(1) Finding effective patent document samples;

(2) Raw indicator value acquisitions;

(3) Normalizing and dimensionless;
(4) Evaluation model applied to valuate patent documents, and identifying the core patent documents wherein;
(5) Investigate the empirical test results by peer review of the technical experts in the given tech field.

Data samples selection

The samples are patent documents from the field of high temperature superconductive (HTS) cables. We first spent considerable time on the search strategies. After careful examination and repeated experimental searches, the search algorithm is constructed. Besides, country (regional) distributions analysis shows the top 2 country players in this field are Japan and US, whose patent applications account for 72% of the total (Zhang, 2009b). Therefore the data sampling focuses on these JP and US patent documents on HTS cables, including wire (belt) material thereof.

Outcomes and findings

According to the calculation results, the core patent documents in the HTS cable field are identified. To examine the accuracy of the results, we conduct peer reviews. The technical experts being familiar with the HTS cable field are invited and grouped into 2 expert panels. Panel A consists of experts from the Institute of Electrical Engineering of Chinese Academy of Sciences. Their research group have conducted HTS R&D in China for nearly 10 years, and successfully commercialized the first set of cables into the power grid operation. Panel B consists of experts from the University of Electronic Science and Technology of China. The PI of this group once was the researcher of Superconductor application projects of Australian Research Council.
Based on the subjective votes, the 2 panels judged these selected patents. According to Panel A's judgement, these selected patents revealed the key issues in the preparation of HTS wires, in particular the most advanced second-generation HTS wire technology. And some of them were particularly critical, which were filed by SuperPower, AMSC and Sumitomo, the current global leading players in HTS wire productions, and almost involved the core technologies within this field.
The Panel B agreed with these selected core patent documents. In their view, the top dozen were particularly critical (Table 1). A scorecard was shown by them to better illustrate their comments. By the experts, these selected patents were the core patent in their field. In addition, the 2 panels gave their comments which suggested there are broad prospects for their commercializing and promotion.

Table 1 Scorecard about the selected core patent documents（100-point scale）

Ranks	Pat. Num.	Empirical test score by the model
1	US 6884527 B2	0.51744
2	US 6716795 B2	0.46851
3	US 6466805 B2	0.46250
4	US 6610632 B2	0.42452
5	US 6195870 B1	0.41581
6	US 6420318 B1	0.38342
7	US 5846910	0.38186
8	US 5827798	0.35523
9	US 6745059 B2	0.34930
10	US 6849580 B2	0.33787
11	US 6906008 B2	0.33562
12	US 5874384 A1	0.32831
13	US 7569521 B2	0.31167

Conclusions and future work

In this study, basing on the evaluation model proposed in our previous study, we succeed in conducting an empirical test to apply this model to value the core patent documents in a particular field. The empirical result supports the validity of the model, and also successfully demonstrates the operability of the evaluation approach.
However, further efforts should be taken to advance this study. Firstly, this empirical test is based on a small sample of a particular field. It is necessary to have more tests in more other technical fields for further verifying. Secondly, our model aims to facilitate practitioners in patent information analysis especially the patent literature workers. As patent evaluation in practical is a very complex work requiring in-depth knowledge of markets, competitors and technology, it implies that there may be an integrated evaluator synthesizing several models, in which our evaluation model acts as one literature model. We believe that this integrated evaluator would play a greater role.

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