

# Technology Roadmap using Patent Keyword

Jongchan Kim<sup>1</sup>, Jiho Kang<sup>1</sup>, Joonhyuck Lee<sup>1</sup>, Sunghae Jun<sup>3</sup>, Sangsung Park<sup>2</sup>, Dongsik Jang<sup>1</sup>

<sup>1</sup>Department of Industrial Management Engineering, Korea University

<sup>2</sup>Graduate School of Management of Technology, Korea University

<sup>3</sup>Department of Statistics, Cheong-ju University

**Abstract:** Technological trend analyses using patents are increasingly developed for effective R&D strategies recently. Especially, a patent map analysis including core patents is widely used. However, extraction of core patents from the map requires experts and consumes enormous time and cost. We propose a quantitative methodology of patent analysis using text mining techniques to solve this problem. This study analyzed the trend of technology of thermal insulation materials by building a patent map based on patent keywords.

**Keywords:** Technology roadmap, Patent map, Keyword analysis, Text mining, Thermal Insulation materials.

## 1. Introduction

In a general process of patent analysis, patent data of target technological area are collected from a patent database and redundant or noise data are eliminated. A quantitative analysis based on descriptive statistics can be carried out using valid data. Through quantitative analyses on patents, varied information such as the number of patents per patentee and the number of patent applications per year date can be attained[1].

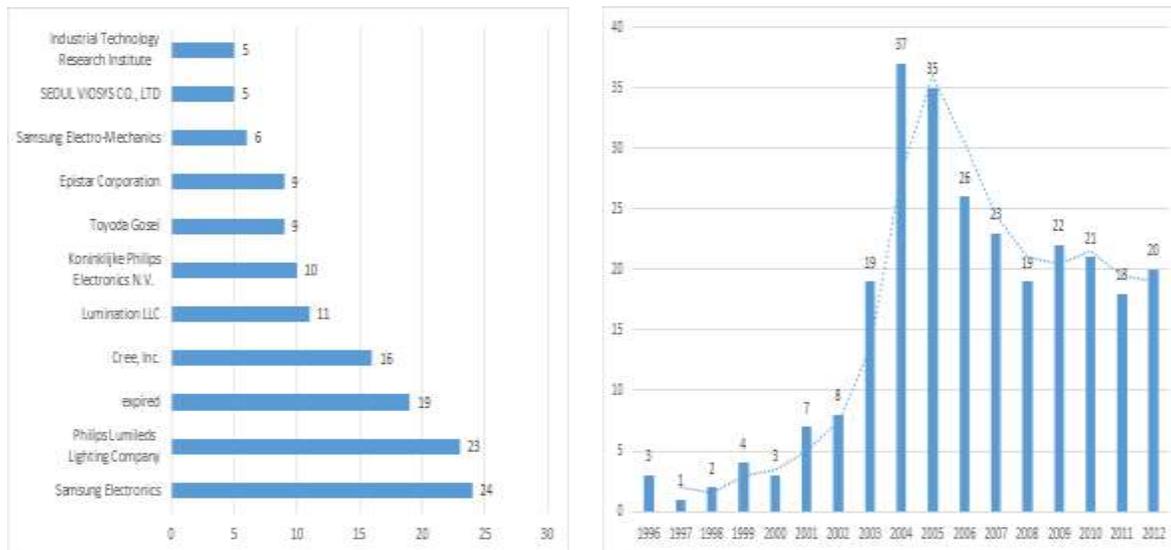


Fig. 1: Number of patents per patentee and number of patent applications per year

In addition to quantitative analyses, a qualitative analysis is also practiced to extract core patents from valid data. In general, about 50 core patents are identified from the collected data ranging from ten thousands to several hundred thousands of patents[2]. The general purpose of the patent analysing process is to find out an overall trend of technologies and label some original patents and promising technologies as core patents. To do this, analyzers utilize some useful techniques like an OS matrix composed of purposes and solutions of technologies and a patent roadmap showing how technologies have been changing over time. By referencing the extracted core patents, specific R&D directions can be determined. Compared to the general R&D process, time, cost and the risk of failures could be drastically reduced through the strategies responding to the core patents with technology acquisition, licensing, differentiated design, invalidation of the existing patents, and so on[3]. However, a qualitative analysis needs experts to read each of patents and choose the important ones based on

their own knowledge and judgement. It requires lots of time, cost and manpower in the course of extracting core patents. There is also some possibility that experts make mistakes and produce inaccurate information. Furthermore, it should be considered that the criteria of determining core patents vary from person to person, which leads to biased results and make it difficult for people to cooperate due to lack of objectivity. Another problem of the current process is that the patent map cannot be considered a comprehensive analysis, because it is created by using only core patents. The following picture represents the general process of patent analysis.

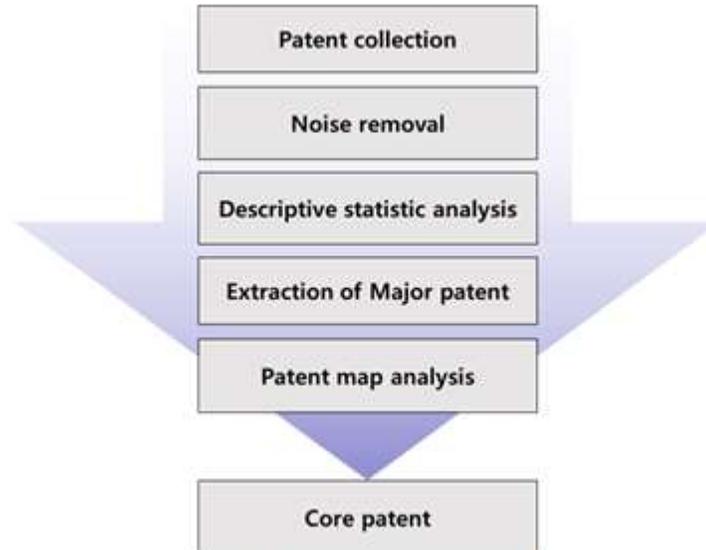


Fig. 2: Patent analysis process for R&D

In order to solve the problems stated above, this research utilizes a technology roadmap based on patent keywords. Instead of conducting qualitative analysis to extract core patents, we propose the methodology of developing a technology roadmap based on patent keywords chosen by text mining techniques. A technology roadmap created by a quantitative method allows us to extract core patents with much reduced time and cost, and the extraction can be made by not only experts but the general. Objects comprising a technology roadmap are not patents but keywords which a number of patent documents commonly have, so the analysis using the roadmap is more comprehensive than that of general process.

## 2. Literature review

### 2.1. Patents

A patent is an exclusive right given to an inventor for a specific period of time in return for publishing his own invention to the public. The purpose of a patent is protecting the rights of inventors in compensation for making their inventions open to the public. Therefore, a patent should include specific description of a technology. Thus, we can make use of patent information for the prediction of technologies.

### 2.2. Text mining

A Text mining, based on natural language processing that can deal with human language, is a technique of creating valuable information by discovering meaningful patterns or relationships from unstructured text data. Unstructured data such as patent documents, papers, tweets, postings on Facebook can be analysed using text mining.

### 2.3. Technology roadmap

Seeing the process of development, it can be understood how technologies of the past have been improved and changed into state-of-the-art technologies. The current method of building a technology roadmap that extracts core patents and arranges them in a time sequence helps developing R&D strategies, visualizing the course of technology evolution[4].

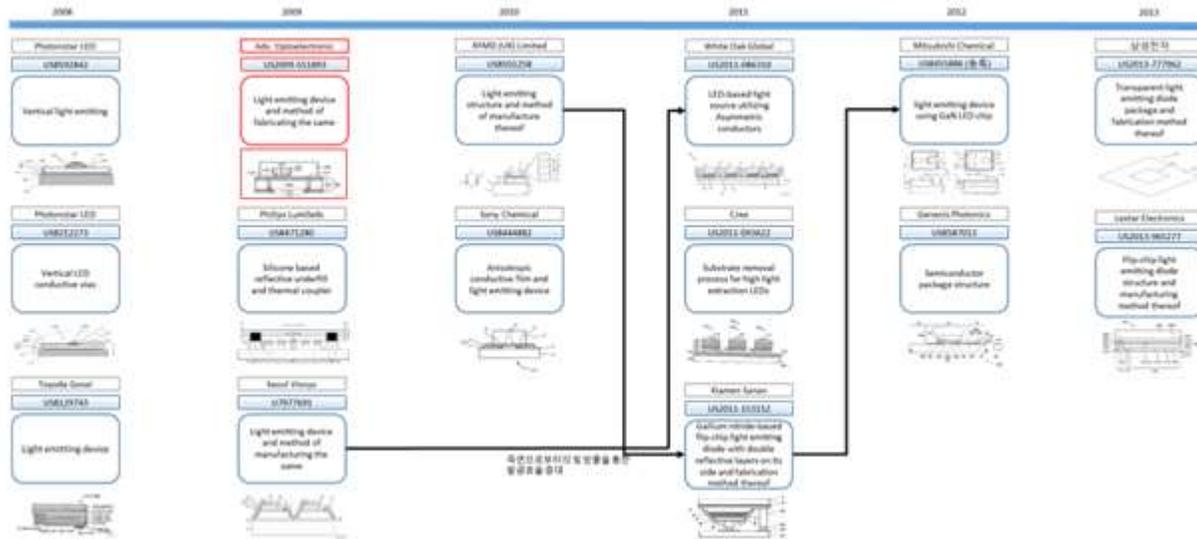


Fig. 3: Technology roadmap using patent

### 3. Research methodology

The analysing process newly proposed in this paper substitutes the step of building a technology roadmap with extracted core patents into the step of developing a technology roadmap using patent keywords of each year.

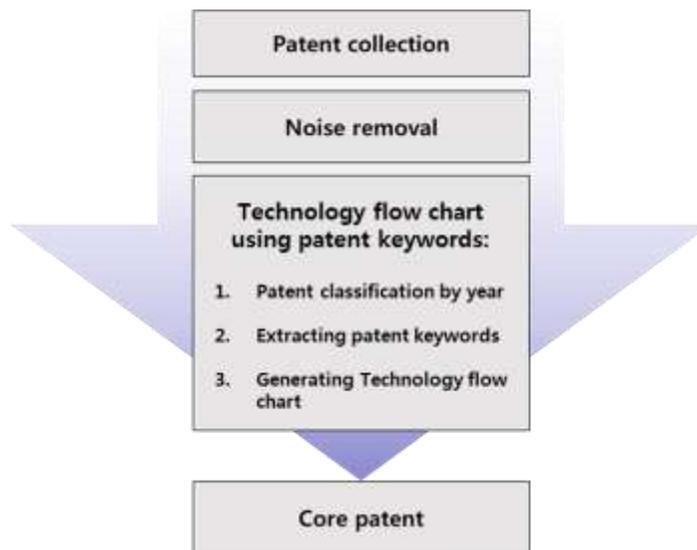


Fig. 4: Research methodology

The process firstly acquires the patents related to the technology of interest with a keyword-searching query from a patent database. When searching patents, a date range, a legal status, a country code, etc. should be set to suit the purpose of the analysis. Secondly, redundant or noise data should be eliminated from collected data. The procedures up to this step are the same with the current process. After that, the valid data remained after pre-processing is classified according to time periods and the keywords of each period are extracted from the titles of patents using text mining techniques. The patents including the same keywords are grouped into the same cluster. By arranging the technology cluster in a chronological order, a technology roadmap consisting of patent keywords is built, the completed technology roadmap is provided to experts so that they can utilize it to develop R&D strategies.

### 4. Experiment

Using the research methodology proposed in the previous section, we made a technology flow chart for the R&D of thermal insulation materials. First of all, the patents filed between 2000 and 2014 in US were collected from the ‘WIPSON’ patent database and totally 367 patents were attained[5].

TABLE I: Patents collected

Database	Search formula	Range	Patents	Country
Wipson	((heat) adj (insulating or insulation)).Ti	1994. 12. 16 ~ 2014. 09. 23.	367	US

As a title is the most important information in a patent document, keywords were extracted from the titles of the patents we collected. Because the patents whose title include one of the words, ‘heat, ‘insulating’ and ‘insulation’, the keywords except for those words were extracted. The patents which have the same keyword were classified into the same group and the 9 most frequently used keywords were identified for the further analysis.

TABLE II: Patents collected

Keyword	Patents
Vacuum	21
Semiconductor	12
Container	29
Glass	9
Cup	9
Film	10
Turbine	9
Layer	13
Structure	55

The table above represents the 9 keywords and the number of patents that include each keyword. Classifying the patents by keywords and years, the following technology flow chart was created.

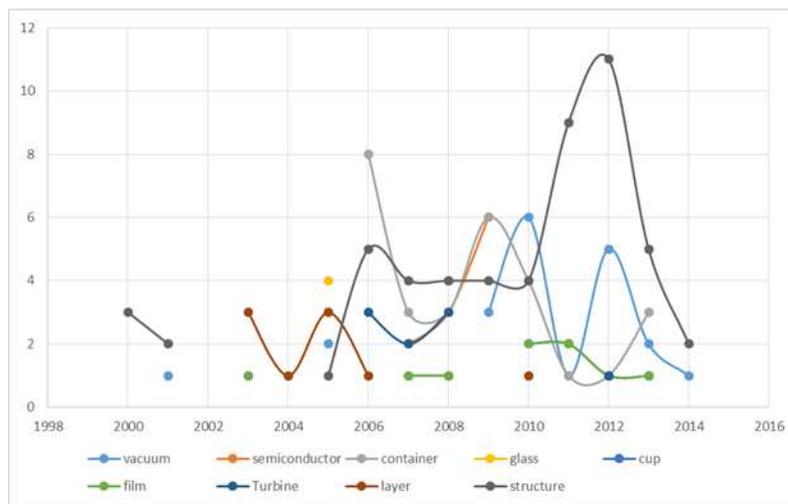


Fig. 5: Technology roadmap using patent keyword

Seeing the chart, the patents including 'structure' appear most frequently and continuously from the early 2000s until a recent date, which implies they are core technology essential for thermal insulation materials. It is found out that the patents with 'cup' and the patents with 'film' are strongly related because they have similar numbers in the same periods. The patents with 'container' that appeared in 2006 for the first time have been steadily developed until a recent date. The patents with 'vacuum' that appeared in 2009 for the first time has been continuously made from 2009 to a recent date. Technologies follow the current trend of technology development, so the technologies related to 'vacuum' and 'container' will still be emerging technologies in the near future.

## 5. Result

This study proposed the methodology for the quantitative analysis of keywords using text mining techniques to improve the problems of the current process of a patent analysis. By using this method, a layman can create a technology roadmap based on patents, which can save time and cost noticeably. We examined the technological trend of thermal insulation materials by the experiment. The 'vacuum' and 'container' technologies were chosen to be the emerging technologies. It was also found out that the 'film' and 'cup' technologies are simultaneously developed. This result is expected to be used to develop effective R&D strategies. A further theme of research for classifying the extracted keywords into the means and the ends of technological problems deserve to be studied.

## 6. Acknowledgements

This work was supported by the BK21 Plus (Big Data in Manufacturing and Logistics Systems, Korea University).

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science, and Technology (NRF-2010-0024163)

## 7. References

- [1] Korean Intellectual Property Office Korea Invention Promotion Association, Patent and Information analysis, Kyungsung Books, 2009, pp. 302-308.
- [2] Korea Intellectual Property Strategy Institute, R&D Innovation Strategy of Patent Perspectives, Korea Intellectual Property Office, 2013, pp.99-122.
- [3] H. Ernst, "Patent information for strategic technology management", World Patent Information, vol. 25(3), pp.233-242, September 2003.  
[http://dx.doi.org/10.1016/S0172-2190\(03\)00077-2](http://dx.doi.org/10.1016/S0172-2190(03)00077-2)
- [4] J. H. Suh and S. C. Park, "Service-oriented Technology Roadmap(SoTRM) using patent map for R&D strategy of service industry", Expert Systems with Applications, vol. 36(3), pp. 6754-6772, April 2009.  
<http://dx.doi.org/10.1016/j.eswa.2008.08.062>
- [5] WIPSON, <http://www.wipson.com>