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Development of a patent roadmap through the Generative Topographic Mapping and Bass diffusion model

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ABSTRACT

This paper aims to present a novel concept roadmap—the patent roadmap—and suggest an advanced patent roadmapping process, based on the Generative Topographic Mapping (GTM) and Bass diffusion model. The process for patent roadmapping is composed of two modules: Developing the GTM-based patent map and determining the appearance time of the emerging patent through Bass model. The result of this research is meaningful knowledge from analyzing a vast store of patent data with quantitative methods and automated tools. It can serve as an effective patent planning tool, and proposes a strategic Research and Business Development (R&BD) for both firms and governments.

1. Introduction

In the present age, intangible intellectual property has gained control of the global marketplace, and the world has entered an era of limitless competition through the development of intellectual property rights in the global marketplace through such means as "patent wars" (Chia, 2012; O'Hearn, 2000). The smartphone industry has become a big story and the international patent infringement trial between Apple and Samsung attracted public attentions. This battle lasted the longest, included the most amounts of products, happened in the most countries, and not finished yet. Apple accused Samsung of infringing on its patents covering the general appearances while Samsung sued Apple copied patents covering 3G networking, MP3 playback, and a method for recording a user's place in a gallery of images. Another battle was a battle between Research in Motion (RIM) who makes BlackBerry, and Nokia. It is not an issue of copying designs, but of using essential patents without paying royalties to the patent holder (Charlton, 2012). These trends make firms perceive the importance of acquisition and exploitation of intellectual property for their innovative invention. Accordingly, most of the enterprises actively tend to consider patent management methods such as a patent portfolio, and patent planning as key areas of business activities, making attempts to manage their intellectual property strategically. In this way, patent disputes have occurred internationally in frequent succession to defend their rights regarding new technologies and the establishment of a solid foothold in world markets such as the display and smartphone industries (Chia, 2012; Lloyd et al., 2011). Besides, the advent of patent trolling has accelerated to bring about patent wars, which shows that the value of intellectual property is superior to any actual assets.

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For research institutes and technology development departments, it is effective to explore new products and novel marketplaces, beginning with patent planning and successive technology development—technology-driven planning. In particular, a well-planned patent in the R&D planning stage can play important role in preventing from imitation by competitors and lead to successful technology commercialization, resulting in making huge profits and creating additional value. Therefore, it is necessary to emphasize the importance of patent planning and forecasting rather than technology forecasting itself.

Patents are an output of the R&D activities of firms, research institutes, and universities including both technological specifications and commercial information such as enterprise information, assignee and inventor information, and cooperative relationships (Ernst, 1997). Since patents are a representative source for the changeover of technology developments in chronological order (Brockhoff, 1991), many studies have been conducted by utilizing the number of patent applications, citation relationships, claims, and patent families (Chen et al., 2010; Curran and Leker, 2011; Ponomarev et al., 2014) in different ways such as through trend analysis (Bigwood, 1997), network analysis (Choi and Park, 2009; Goetze, 2010; Verspagen, 2007; Wartburg et al., 2005), and principal component analysis (PCA) (Lee et al., 2009). Bigwood (1997) tracked the rate of publication of patents over time by utilizing trend analysis, and provided information concerning technological maturity and a corporation's technological strategies. Kash and Rycoft (2000) suggested a framework offering insight into the three distinctive patterns of innovation that are evident in the evolution of six technologies. The first one—the normal pattern—was represented as a stable network and repeated improvements of the same basic technology design through a self-organizing network (SON). Other patterns were transformation and transition patterns defined by new technologies and new networks. These new technologies might be an output of modifications to established technologies or the creation of fundamentally new designs. Wartburg et al. (2005) applied patent citation analysis for the measurement of inventive progress, thereby determining technological change, and contributing to the discussion with in-depth methodological reflection and the potential of citation network analysis for explaining technological changes. In particular, Roepke and Moehrle (2014) suggested the concept of technology DNA for characterizing technological fields by means of patent classifications and analytical coding.

However, previous studies have focused on existing indicators such as the number of citation and the number of patent application for identifying trajectory of technology development (Hidalgo and Gabaly, 2012). Besides, they have conducted research studies that are relevant to patent forecasting rather than planning. Thus, previous studies could forecast the trends of patent applications quantitatively or just explore potential patents or technology for a certain period, rather than performing stepwise patent planning in detail. Therefore, it is appropriate to establish a patent roadmap leading to a new patent planning and forecasting approach. Therefore, this study aims to suggest a patent roadmapping approach through the Generative Topographic Mapping (GTM) and Bass model. The suggested process consists of two modules—planning contents of promising patents and forecasting the appearance time of new patents. In planning the content of a patent, the GTM technique which is widely used as a visualization tool (Son et al., 2012; Jeong and Yoon, 2013), is applied to establish a patent map for the purpose of exploring patent vacuums. They are considered as promising nodes in patent roadmaps, and then, appropriate timing when they will be applied as patents is forecasted through the Bass model. In particular, the Bass model is chosen to consider factors influencing technology innovation because it is composed of several parameters reflecting imitation and innovation effects when emerging technology is adopted or diffused. The proposed approach depends on quantitative analysis with historical patent data and gains insight into patents that represents an ample source for analyzing technology and markets. Patent data serves as a critical source for identifying undeveloped areas and deriving contents of new patents in this study. Since existing patents are able to provide trajectory of technology development until now, it is necessary to analyze and review historical data despite of outdated data in order to avoid duplication with previous invention and extrapolate recent trends.

This research will suggest contents and timing of novel patent application through quantitative analysis and systematic framework, while examining vacuum technologies. Furthermore, it will become a baseline for strategic patent planning and technological developments for researchers in diverse research organizations and firms. For many enterprises and governments, patent roadmaps will serve as a tool for supporting resource allocation to promising areas for the commercialization of research and technology.

This paper is structured as follows: Section 2 contains review-related studies on patent planning, including patent roadmaps and both GTM and Bass models. The overall specific process to develop patent roadmaps will be explained in Section 3. In Section 4, a proposed methodology for patent roadmapping will be illustrated using mobile communication technology, and conclusions from this research will suggest directions for future study in Section 5.

2. Background

2.1. Patent planning and patent roadmap

The importance of patent planning has increased continuously in light of recent circumstances in which firms have struggled for patent infringement protection in the display and smartphone industries. In particular, the patent provides a legal right whereby no one can imitate the content of the inventions mentioned in the patents, so it is critical to occupy a valuable patent in advance to dominate the market and remain competitive. Moreover, the advent of patent trolling has raised both the value of intellectual property and the importance of planning for valuable patents. Nevertheless, a few

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