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Mapping university receptor patents based on claim-embodiment quantitative analysis: A study of 31 cases from the University of Tokyo

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ABSTRACT

This study aimed to develop a quantitative method that is capable of mapping university patents by analyzing the contents of the claims and examples provided in patent specifications. First, two scoring parameters related to the claims and the exemplified embodiment were defined to assess the grantability of a patent application. Second, several assumptions were formulated, and a model was constructed based on these assumptions. A collection of 31 university patent applications in the biomedical field were studied in depth to validate the model.

1. Introduction

The knowledge generated by academic scientists has been deemed one of the most crucial ingredients for technological progress and economic growth. Publicly financed research feeds and supports the private sectors, mainly by the transfer of knowledge, in turn, creating new job vacancies and generating income. Findings generated from public research institutions constitute the theoretical basis for the majority of industrial patents. Narin et al.'s [1] study showed that 73% of the academic literature cited by US patents belonging to the private sector is published by governmental, academic, and other public institutions. Thus, for a long time, science policies have paid close attention to more efficient tools for improving the exploitation of the knowledge generated in universities [1]. In particular, in Japan and Europe, many governments followed the example of the US Bayh-Dole Act, in order to encourage universities to participate in the management of inventions produced by their staff such as technology transfer activities. Kneller [2] described the changes in the regulations of university intellectual property rights in Japan, and their effects on university patenting activities and knowledge transfer processes. According to this view, academic scientists should contribute to innovation activity not only by conducting the actual scientific work, but also by bringing about patentable inventions that are susceptible of industrial application [2].

The growing emphasis on patent issues and the financial straits of public research funds have gradually altered the incentives for academic scientists, and have forced them to face increasing pressure to patent. On these grounds, an unignorable concern is that related to the possible shift of academic resources toward more application-oriented research, and the patenting of inventions with lower technological and economic significance [3] [4]. Thus, many scholars have studied patent quality issues by scrutinizing their determinants and changes over time. The typical measures of patent quality used in the literature are generally external metrics: (1) the number of backward citations in the search report established by a patent office [5]; (2) number of forward citations, which suggest the relevance of a certain patent for further research or

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development [6]; (3) success or failure of the patent itself, namely the patent application acceptance or denial [7]; (4) whether patent disputes existed [8]; and (5) whether patent renewal existed [9]. However, few studies have assessed patent quality by analyzing the contents in the claim or embodiment of the patents or patent applications.

Based on the above-mentioned gap in the literature, this study aims to develop a quantitative method that is capable of evaluating patent quality, using novel inner metrics generated from the contents of the academic patent applications.

2. Model construction

2.1. Claim, sufficiency of disclosure, and embodiment

In technical terms, the claims define the scope of the protection sought in a patent application [10], and are of utmost importance to both prosecution and litigation alike. Sufficiency of disclosure is a patent law requirement, according to which a patent application must disclose a claimed invention with sufficient detail for the person skilled in the art to carry out that invention [11]. This requirement is pivotal to patent law; in return for teaching the public how to use or create the invention, a monopoly is granted for a given period [12]. Moreover, a patentee who claims more than he or she disclosed has failed to fulfill this requirement, by keeping his or her invention secret while taking advantage of the patent law's monopoly [13]. This will lead to rejection from the patent examiner. Embodiment is a disclosed example of how an inventive concept can be put into practice, and it is crucial for the patent application to meet the sufficiency of disclosure requirement [14].

2.2. Appliedness and concreteness

Two parameters have been designed for evaluating the grantability of a patent application, as follows:

Appliedness (APP) is defined as the extent to which the claims of patent applications encompass the potential application of a claimed invention. For example, a claimed antibody may be used in practice as an immunological treatment or as a diagnostic tool. In addition, there could be several pathways for one basic research outcome, to reach different marketable products. Wessling et al. [15] describe the pathways from the basic research of polymer science to various commercial applications. In this study, we take all of the possible pathways into consideration.

Concreteness (CON) is defined as the extent to which the claims encompass the experimental data provided in the patent application. Embodiments of an invention described in a patent application can be described in terms of "prophetic" examples or "working" examples. Prophetic examples are based on predicted results [16], while working examples are based on the work actually performed [16]. Patents applications with prophetic examples only are assigned lower CON value by the authors than the patent applications providing "working" examples.

Based on the above-mentioned two parameters, three assumptions were made by the authors, as follows:

2.2.1. Assumption 1: grantability threshold

According to the definition of sufficiency of disclosure, patent applications that fall above a certain CON/APP-ratio threshold, which hereinafter is named the grantability threshold (as shown in Fig. 1), are more likely to fulfill the sufficiency of disclosure requirement and, therefore, be more likely to grant.

2.2.2. Assumption 2: minimum APP for basic/applied interface

Basic research is directed toward greater knowledge, without considering a practical end goal, and without specific applications in mind. In contrast, applied research is research focused on a particular application or solution to a given problem [17]. There is a need to bridge the gap between basic and applied research in order for the outcome of the basic research to be beneficial to society eventually [18]. We define *the interface between basic and applied research* as the first step in translating a basic research outcome into an application. In other words, the APP needs to surpass a minimum threshold for the patent application to cover this interface as well as the basic research, as shown in Fig. 2.

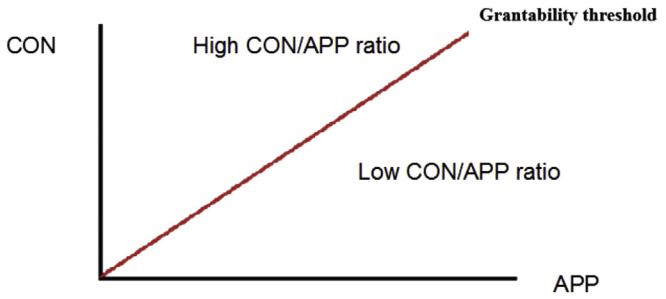

Fig. 1. Grantability threshold.

2.2.3. Assumption 3: limitation of CON for universities

The experiments for applied research are often capital-intensive and primarily funded by companies [19], meaning that universities could only afford a small portion of applied research, due to resource limitation. Thus, we could easily assume that a *limitation of CON for a university patent* exists (as shown in Fig. 3), since only a limited number of applied-research experiments can be conducted within a university.

3. Methodology

3.1. Target-based drug discovery and receptors

Target-based drug discovery, focusing on a genetic target, will have the goal of developing a drug that selectively stimulates or inhibits the function of the disease-related gene, without affecting other genes or molecular mechanisms in the organism [20]. The conventional physiology-based approach was replaced by the target-based drug discovery paradigm over 10 years ago, because the new paradigm allowed an increased screening capacity, and provided the definition of rational drug discovery programs [21]. It was believed that this approach would result in a dramatic increase in R&D productivity in the pharmaceutical industry. Generally, this approach has five components: (1) target identification, where the drug target and specific patient population are identified; (2) target validation, where the potential therapeutic value, based on the target, is determined; (3) development of the assay, where the target is expressed in a high throughput system; (4) lead identification, where chemical libraries are screened for identification of target-specific compounds; and (5) lead optimization, where lead chemicals are optimized for pharmaceutically acceptable affinity and selectivity [20].

After the sequencing of the human genome, a rich source of emerging drug targets arose. However, target-based drug discovery remains a largely unexploited area. In 1997, Drews et al. [22] estimated that the human genome contained 266 proteins that could be targeted by pharmacological agents. They were able to assign a total of 324 molecular targets to 1065 pharmacological agents, by a systematic review of the FDA Orange Book and the Center for Biologics Evaluation and Research's website [22]. This analysis led to