Patent portfolio analysis of the cloud computing industry

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ABSTRACT

In recent years, cloud computing has become a popular theme in the area of network technology; however, related literature on patent analysis is limited. This study seeks to reveal the technological trends and competition status of cloud computing industry by proposing a hybrid patent portfolio analysis scheme. First, the technique for order preference by similarity to ideal solution (TOPSIS) is adopted to integrate the relevant indicators of patent quality into new indices of patent quality, which are normally evaluated by the cited ratio only. Next, multivariate analysis techniques are employed to provide supplementary information to the R&D decision maker. By conducting factor analysis (FA) on patent class codes under the international patent classification (IPC), this study reveals that there are three mainstream technologies of cloud computing: including virtualization and information retrieval, network system, and commercial data process. This study not only uses multidimensional scaling analysis (MDS) to illustrate the proximity of technologies and firms on a perceptual map, but also applies the grey relational analysis (GRA) method to provide quantitative data for interpreting the perceptual relations. Based on the analysis results, the technological strength and the R&D strategies of several big companies are investigated. The findings of this study can provide valuable references for enterprises that wish to develop technologies and deploy their patent portfolios of cloud computing.

1. Introduction

In recent years, many enterprises have considered cloud computing as a seminal technology. Numerous cloud computing services and platforms have increased dramatically, including notable examples such as Google's File System (GFS), Amazon's Dynamo, and Microsoft's Azure. Owing to rapid market and technological changes, network-related enterprises must monitor the trends of technological development from time to time. A high-tech enterprise needs to make strategic decisions based on the information acquired on the volatility of technology in order to chart its direction in the marketplace, which involve determining the market segment in which it will compete and the competitive position that it will take. To this end, patent portfolio analysis has been employed by many enterprises and proved to be a very usable tool for R&D decision makers (Ernst and Omland, 2011).

Nowadays, the effective use of scarce resources in R&D projects to yield the most profound and sustainable advantages over the increasingly fierce competition are becoming more and more important (Mohr et al., 2010). The technological trend of cloud computing has so far been actively driven by certain enterprises that control most of the market share. Among them,

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20 cloud computing enterprises (henceforth called the samples or the targeted enterprises) nominated from specialized marketing reports (magazines such as CIO, Network World, and Computer Reseller News) are targeted for analysis. These include Adobe (Ad.), Amazon (Am.), Apple (Ap.), Cisco (Cis.), Citrix (Cit.), Dell (De.), EMC (EM.), Google (Go.), Huawei (Hu.), Juniper (Ju.), Microsoft (Mi.), Novell (No.), Oracle (Or.), Parallels (Pa.), Red Hat (Re.), Salesforce (Sa.), SAP (SAP), Sun (Su.), Verizon (Ve.), and VMware (VM.). Fast followers who try to imitate the leader's successful business model should make appropriate strategy decisions before entering this market. This motivates us to investigate the patent portfolios and the R&D planning of big companies in the cloud computing industry.

The remainder of this paper is organized as follows: the status of the patent analysis of cloud computing is presented in Section 2. Section 3 provides a description of the proposed compound policy for retrieving the patents of cloud computing. In Section 4, based on the new indexes that are integrated from several relevant indicators of patent quality through the technique for order preference by similarity to ideal solution (TOPSIS), we conduct patent portfolio analysis at both the company and the technological levels. In Section 5, we employ factor analysis (FA), multidimensional scaling analysis (MDS), and grey relational analysis (GRA) to investigate the R&D strategies and competence statuses of all enterprises. Finally, Section 6 contains our concluding remarks and suggestions for future research. One may refer to Fig. 1 for the overall process of the proposed hybrid patent portfolio analysis scheme.

2. Literature review

Cloud computing is a style of computing where scalable and elastic IT-related capabilities are provided as a service to external customers using Internet technologies (Bal, 2012; Madhavaiah et al., 2012). In fact, cloud computing is not a new technology; it is a system that allows data to be located centrally and accessed by businesses through a network. It is similar to the concepts that have been recognized since the 1950s in the work done by AT&T in the area of telephone networking.

The essence of cloud computing is inherited from distributed computing and grid computing (Li et al., 2015). Distributed computing is a field of computer science that studies distributed systems, which consist of multiple autonomous computers that communicate through a computer network, and the computers interact with one another in order to achieve a common task that a single computer would not be able to do. Grid computing is a technology that applies the resources of many computers in a network to a single problem at the same time. One example of grid computing in the public domain is the ongoing Search for Extraterrestrial Intelligence (SETI)@Home project that started in 1999; since then, more than 5 million computers of participants are used to analyze the operation of radio signals with the hope of finding life in outer space.

The National Institute of Standards and Technology (NIST) clearly defined the following three service models related to cloud computing (known as the SPI model): SaaS (software as a service), PaaS (platform as a service), and IaaS (infrastructure as a service). SaaS is a network that provides various softwares for users; PaaS offers a full or partial application development
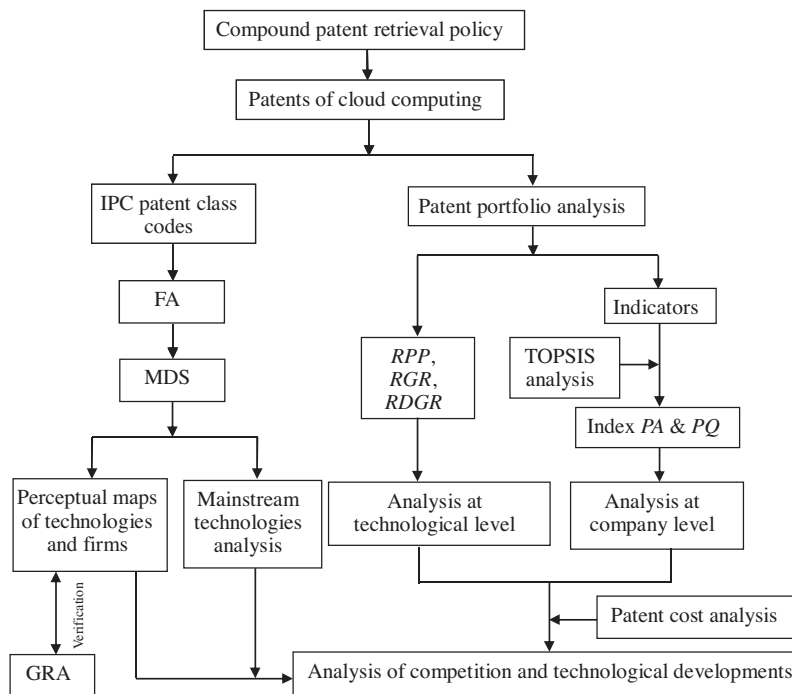

Fig. 1. Overall framework of hybrid patent portfolio analysis.