Chapter 6

TOPOLOGICAL ANALYSIS OF PATENT CITATION NETWORKS: NANOTECHNOLOGY AT USPTO, 1976-2004

CHAPTER OVERVIEW

Patent citation is an indicator of technological development in individual institutions or countries. The patent citation networks provide additional insights into the technology landscape and knowledge transfer processes for a specific field. This chapter presents an analysis framework that applies three approaches to provide a systematic view of patent citation relationships. The three approaches – critical node analysis, core network analysis, and network topological analysis – facilitate the identification of key players/subfields and the knowledge transfer patterns among them. We applied our framework to nanotechnology and analyzed nanotechnology citation networks of patents, institutions, technology fields, and countries. The citation network analysis shows that the U.S. is the most important citation center in nanotechnology research. The institution citation network allows knowledge to transfer more quickly between institutions than a random network. The country citation network provides as efficient knowledge transfer capability as the random network. The technology field citation network and the patent citation network provide less efficient knowledge diffusion capability than the random network. The country citation network, the institution citation network, and the patent citation network of the nanotechnology field all show a tendency to form local citation clusters.
1. INTRODUCTION

Information on current technology outcomes and knowledge diffusion patterns is important in planning and managing technology development. In previous studies, bibliometric patent analysis is well accepted in the evaluation of the productivity and quality of industry research and development (R&D). Patent citation information has been used to assess the knowledge diffusion and transfer processes in research and development.

Typical performance measures based on patent citation counts (e.g., number of cites of a patent or an assignee) describe the "local" characteristics of knowledge conveyance. Leveraging recent scientific advances, a network view of the patent citation relations may provide us with a better understanding of the global characteristics of the knowledge diffusion process.

In this study, we propose a framework for the construction and analysis of patent citation networks. From the structured patent documents, we utilize the patent-to-patent citation information and important entities associated with each patent (i.e., country, institution, and technology field) to construct patent citation networks of different entities. Critical node analysis is applied to identify the key players/subfields of the field. The core network is visualized in order to identify the knowledge transfer patterns among the key players/subfields. We also apply network topological modeling techniques to analyze the global structure of the patent citation networks and characterize the global knowledge transfer process based on network topological measures.

2. RELEVANT LITERATURE

Patents represent critical technological advances for many industries. Patents and patent citations have frequently been used as indicators of research productivity and research impact (Narin, 1994). Lewison (Lewison, 1998) assessed different funding sources’ impact on Gastroenterology research in the UK using patent analysis. Huang et al. (Huang et al., 2003a) explored research and development in the high-tech electronic companies of Taiwan based on patent information. In several large-scale longitudinal studies (Huang et al., 2003; 2004; 2005; 2006), Chen and his team at the University of Arizona analyzed the evolution and change of the international landscape of nanotechnology research and development using the complete nanotechnology patent data set collected from the United States Patent and Trademark Office (USPTO) database.