Paper to be presented at the

35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19

Exploring Knowledge Diffusion among Nations: The Study of Core Technologies in Fuel Cell

Mei HC Ho
National Taiwan University of Science & Technology
Graduate Institute of Technology Management
mei.hc.ho@gmail.com

Abstract

Technological trajectory explains the development process of technology. Based on the analysis of prominent technology on the trajectories, we can further explore the phenomena of technology evolution and knowledge diffusion. In this study, we focus on explaining the knowledge diffusion in the core technology used in fuel cells, which are important in developing green energy. By the investigation of patent citation network, path analysis and regression analysis, this study aims to explore how the knowledge of this technology evolve and diffuse across different locations. This study uses patents data about fuel cell?s 5-layer MEA technologies. We collect data from US Patent office, totally 1356 patents. A patent citation network is built based on citation relationships, and some prominent ones with higher citation are recognized with path analysis. By local main path analysis and global key-route method, we identify three stages of the technological development, including the improvement of Proton Exchange Membrane (PEM) and catalyst synthesis. Additionally, the study uses regression analysis to show that patents with specific characteristics play a relative important role in the process of knowledge diffusion. Specific locational factor (nation), e.g. patents from Japanese and Korean, are relative important than the patents invented by other countries Patent?s brokerage characters, e.g. intra-national coordinating characteristics or patents liaising among more than two countries, also facilitate the diffusion of technological knowledge. However, the importance of the brokerages changes when we concern the inventing time. Patent?s technological diversification has no significant influence on patent?s network position.

Jelcodes:O39,R11

Exploring Knowledge Diffusion among Nations: The Study of Core Technologies in Fuel Cells

Mei Hsiu-Ching Ho*
Vincent H. Lin*
John S. Liu*

***: National Taiwan University of Science and Technology**

Abstract

Technological trajectory explains the development process of technology. Based on the analysis of prominent technology on the trajectories, we can further explore the phenomena of technology evolution and knowledge diffusion. In this study we focus on explaining knowledge diffusion in the core technology used in fuel cells, which are important in developing green energy. Through an investigation of the patent citation network, path analysis, and regression analysis, this study explores how the knowledge of this technology has evolved and diffuses across different locations.

This study uses patent data about fuel cells' 5-layer MEA technologies. We collect data from the U.S. Patent office, for a total of 1356 patents, and build a patent citation network based on citation relationships, recognizing some prominent ones with higher citations through path analysis. By local main path analysis and the global key-route method, we identify three stages of technological development, including the improvement of Proton Exchange Membrane (PEM) and catalyst synthesis. Additionally, the study uses regression analysis to show that patents with specific characteristics play a relatively important role in the process of knowledge diffusion. Specific locational factors (nations), e.g. patents from Japan and South Korea, are relatively more important than patents invented by other countries. A patent's brokerage characteristics, e.g. intra-national coordinating characteristics or patents liaising among more than two countries, also facilitate the diffusion of technological knowledge. However, the importance of these brokerages changes when we look at inventing time. A patent's technological diversification has no significant influence on its network position.

Key words: Technological trajectory, patent citation network, knowledge diffusion, Proton Exchange Membrane Fuel Cells (PEMFCs), Membrane Electrode Assembly (MEA)

Exploring Knowledge Diffusion among Nations:
The Study of Core Technologies in Fuel Cells

1. Introduction

Knowledge diffusion facilitates technological progress and motivates more new innovations in the fast changing generation in the present era of fast changes. A popular commercialized product always consists of much previous technological knowledge and accumulated experiences. From a long-run historical perspective, the technological development may face different alternatives to develop other applications, or the path may face a very limited choice to construct the main path. Observing the development of a specific technology seems to explain how the world chooses the most feasible technology to create new innovations. This study first aims to explore the path of technology development. To reach the goal of sustainable development, many countries have now started to pay attention on green energy, or advanced technology, for energy savings and emission reductions. We choose to focus on discussing the core technology applied in fuel cells, i.e. Membrane Electrode Assembly (MEA).

Whether a certain technology plays a critical role in the whole evolution process depends on whether its technological knowledge is helpful for new developments and applications. Some technologies play critical roles, because the home countries have invested a lot of resources on their development, while others are influential, because they provide the most critical technological knowledge for new applications. Much knowledge interaction and diffusion is needed in order to motivate the development of technologies. Therefore, aside from observing the development of core technology in fuel cells, this study also explores the determinants for how a technology plays a critical role in the process of knowledge diffusion.

In the next section we discuss the relationship between location and knowledge diffusion, as well as the importance of brokerages' characteristics in knowledge diffusion. The third section focuses on the main path analysis by which we observe the development of MEA technology. The fourth section discusses the patent dataset and variable definitions, whereas the fifth section presents the results and implications of the main path analysis and the empirical model. The final section summarizes all findings and discusses the limitations.