Research Policy xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Dynamic patterns of industry convergence: Evidence from a large amount of unstructured data

Namil Kim [a], Hyeokseong Lee [b], Wonjoon Kim [a,b,*], Hyunjong Lee [c], Jong Hwan Suh [d]

[a] Department of Business and Technology Management, KAIST, South Korea
[b] Graduate School of Innovation and Technology Management, KAIST, South Korea
[c] Department of Computer Science, KAIST, South Korea
[d] Research Center for Future Strategy, Graduate School of Future Strategy, KAIST, South Korea

ARTICLE INFO

Article history:
Received 4 February 2015
Accepted 8 February 2015
Available online xxx

Keywords:
Co-occurrence-based analysis
Industry convergence
Industry convergence index
Industry convergence map
Unstructured data

ABSTRACT

Because of the accelerated life cycle in technology and correspondingly rapid technological saturation in markets, firms are not only accelerating the rate of technological innovation but also expanding the scope of their products or services by combining product or service features of other markets, which eventually leads to industry convergence. However, despite the significant impact of industry convergence on the economy, our understanding of the phenomenon is still limited because previous studies explored only a few cases and come largely from the technological perspective. Therefore, it is still questionable whether industry convergence is a general phenomenon that is prevalent across entire industries. In this paper, we analyze the phenomenon in entire U.S. industries, focusing on its trends and patterns. To do so, we conduct a co-occurrence-based analysis of text mining for a large volume of unstructured data – 2 million newspaper articles from 1989 to 2012 – and suggest using an industry convergence (IC) index based on normalized pointwise mutual information (PMI). We find that overall industry convergence is increasing over time. Moreover, the rate of the increase has been greater within industry than between industries at a given industry level. However, when we cluster the dynamic patterns of industry convergence among industry pairs, the patterns are mixed, and, while some industry groups are converging over time, others are stationary. These findings suggest that significant transformation is under way in the economy, but this phenomenon is not yet prevalent across entire industries. In addition, this study provides a method for anticipating the future direction of industry convergence.

1. Introduction

Because of the accelerated life cycle in technology and correspondingly rapid technological saturation in markets, firms are not only accelerating the rate of technological innovation but also expanding the scope of their products or services by combining product or service features of other markets – that is, market convergence, which eventually leads to industry convergence. Many examples of this industry convergence are available, such as the automotive industry, which has accelerated its functional integration with electronics and software (Adamsson, 2007; Hacklin and Wallin, 2013); the construction industry, which has generated intelligent building construction based on convergence between material design and electronics (Hacklin et al., 2009); and the nutraceutical and functional food industry, which involves convergence between the food and pharmaceutical industries (Bröring and Leker, 2007; Curran and Leker, 2011; Curran et al., 2010; Preschitschek et al., 2013; Weenen et al., 2013).

This industry convergence triggers restructuring in traditional industry and leads to the emergence of a new industry. For example, the mobile phone industry has been significantly restructured, and the smartphone industry has emerged as a result of the integration of a variety of functionalities, such as high-resolution photography, high-speed web browsing, GPS-based navigation, and application contents that were previously in different product categories in different industries. In this turbulence, firms that cannot adjust to this trend of industry convergence eventually lose their market position and fail in the market. Nokia is a prime example, and its failure led to its acquisition by Microsoft in September 2013 (Hacklin et al., 2013).

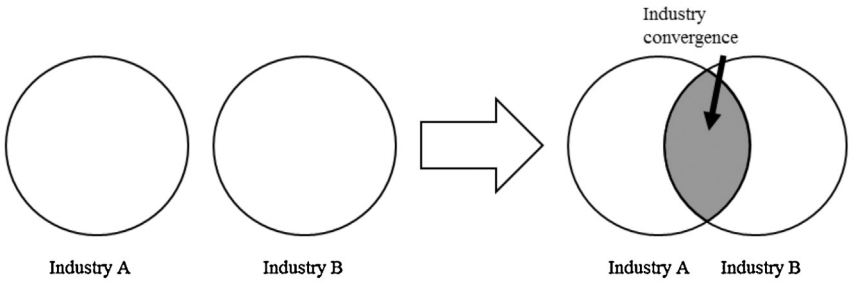
In view of this increasing evidence of and importance of industry convergence, researchers have attempted to understand this phenomenon (e.g., Bröring and Leker, 2007; Curran and Leker, 2011;

* Corresponding author. Tel.: +82 42 350 4336.
E-mail addresses: namil.kim@kaist.ac.kr (N. Kim), leehyeoks@kaist.ac.kr (H. Lee), wonjoon.kim@kaist.edu (W. Kim), hyunjong.lee.s@gmail.com (H. Lee), suhjonghwan@kaist.ac.kr (J.H. Suh).

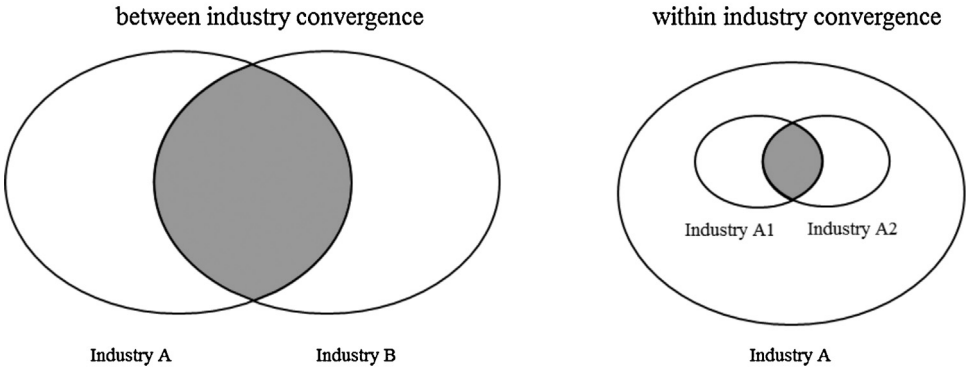
http://dx.doi.org/10.1016/j.respol.2015.02.001
0048-7333/

Curran et al., 2010). For example, some recent studies have analyzed the patterns of industry convergence from the technological perspective using patent information (e.g., Curran and Leker, 2011; Curran et al., 2010; Preschitschek et al., 2013; Weenen et al., 2013). These studies contributed significantly to our understanding of the phenomenon. However, they have some limitations: although the patent analysis in previous studies provides important information about how industry converges at the technological level, it does not provide any market-level evidence of industry convergence. Furthermore, those studies only covered a few industries, such as smartphones, functional foods, and intelligent buildings. Therefore, it is still questionable whether industry convergence is a general phenomenon and prevalent across industries or a phenomenon that affects only some industries.

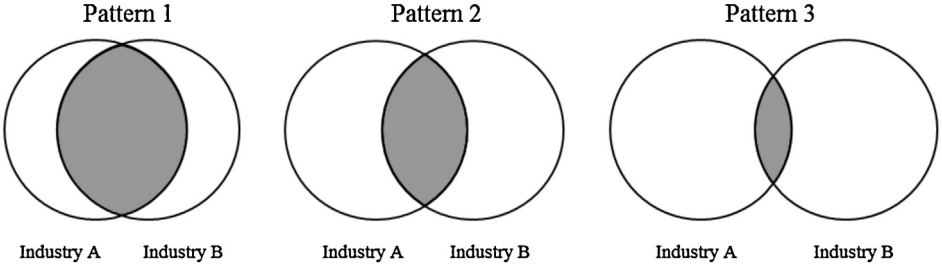
Therefore, this paper analyzes industry convergence in entire U.S. industries, focusing on its trends and patterns. More specifically, we analyze whether industry convergence arises differently depending on the scope of industry, that is, whether industry convergence is a more salient phenomenon within industry or between industries from the perspective of absorptive capacity, interorganizational diversification, and path dependence. Then, we examine whether the dynamic patterns of industry convergence are heterogeneous across different industry pairs. To answer these questions, we analyze a large and comprehensive set of information: articles published in a major daily newspaper in the United States, spanning 24 years from 1989 to 2012. The data cover about 2 million articles, including all industry sectors as well as around 13,000 companies in the United States. Surprisingly, the news articles had



a: visualization of industry convergence



b: within- and between- industry convergence at a given industry level



c: patterns of industry convergence

Fig. 1. The concept of industry convergence.

Please cite this article in press as: Kim, N., et al., Dynamic patterns of industry convergence: Evidence from a large amount of unstructured data. Res. Policy (2015), http://dx.doi.org/10.1016/j.respol.2015.02.001