

## Chapter 10

# Mapping Innovation in the Digital Transformation Era: The Role of Technology Convergence

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### ABSTRACT

*Digital transformation is imperative for gaining and sustaining a firm's competitive advantage. Hence, understanding the dynamics of technology evolution becomes salient for both scholars and practitioners. This chapter aims to provide a complementary perspective to the field of innovation by mapping and visualizing the patterns of digital transformation at the industry level with a particular focus on the role of technology convergence. The authors tracked 20 years of the technology of the U.S. communications industry in order to investigate how digital transformation has shaped the industry technological structure, which are the technological gaps and potential future technology trends. The results show a deep transformation of the industry with many interconnections between technology domains and a high degree of overlap between technology areas.*

## INTRODUCTION

In the past few decades, high-technology industries have experienced an important evolution connected with the advancement of digital innovations, regulatory changes, as well as new consumer preferences (Curran & Leker, 2011). At the same time, scholars have been drawing increasing attention to the phenomenon of digital transformation, defining it as crucial for firm growth and success (Yoo, Boland, Lyytinen, & Majchrzak, 2012; Hess, Matt, Benlian, & Wiesböck, 2016; Soule, Puram, Westerman, & Bonnet, 2016; Schweer & Sahl, 2017; Singh & Hess, 2017). Indeed, the potential benefits resulting from this digitization trend—including big data, the Internet of things, mobile computing and cloud computing—are enormous (Fitzgerald et al., 2014; Peppard & Ward, 2016). Digitalization has reshaped the way we work and live by introducing new and more disruptive technologies. This rapid transformation continually leaves traces in the technological space reshaping the industry's technological structure. In order to capture these changes across time, the present study aims at mapping and visualizing technology and innovation in the digital transformation era. More specifically, the authors attempt to explore the technology trajectory and patterns at the industry level in order to unveil the dynamics of the evolution of digitalization, to identify its most active technological areas and focal streams.

Digital transformation is a very broad phenomenon that covers several aspects. Zhu, Kramer, and Xu (2006) have examined the digital transformation process in different countries showing that it is influenced by contextual factors including the technological, organizational, and environmental contexts have focused on the technological, organizational, and environmental factors. Other studies have revisited the innovation appropriability dynamics (Teece, 2018; Helfat & Raubitchek, 2018), while other works have examined digital transformation at individual level (i.e. Stolterman & Fors, 2004; Lanzolla & Giudici, 2017) or at the industry level (i.e. Agarwal, Gao, DesRoches, & Jha, 2010). However, studies that investigate the digital transformation process within the technology convergence and industry evolution paradigms are still absent.

Our goal in this chapter is to explore one aspect of digital transformation related to how it has affected the technology innovations generated by firms and how it can be explained through the technological convergence paradigm. Consistent with our goal, we analyzed the communication services industry as its digital transformation is evident, it has been a key driver of the worldwide digitization and as such it is positioned at the forefront of the deep transformation that comprehends new information technologies such as broadband networks, mobile communications, and the Internet (Maitland, Bauer, & Westerveld, 2002; Andal-Ancion *et al.*, 2003).

Moreover, the technology literature has widely shown the crucial role of patents as a meaningful instrument to measure the innovation performance (Trajtenberg, 1990; Ahuja & Katila, 2001; Hagedoorn & Cloudt, 2003; Di Guardo & Harrigan, 2016), to capture the multifaceted dimensions of technology (i.e. Hall, Jaffe, & Trajtenberg, 2001; Harrigan, Di Guardo, Marku, & Velez, 2017), to track the knowledge flows and spillovers (i.e. Jaffe A., 1986), and to monitor convergence and emerging technologies in the digital transformation era (Tijssen, 1992; Engelsman & van Raan, 1994; Archibugi & Pianta, 1996; Curran & Leker, 2011; De Rassenfosse *et al.*, 2013; Lee, Park, & Kang, 2018).

Based on patent co-classification analysis (Engelsman & van Raan, 1994), this study examines the digital transformation of the U.S. communications industry in a 20-year time interval that goes from 1992 to 2011. Patent co-classification analysis is widely acknowledged as a valid alternative to the most widespread patent co-citation analysis (Tijssen, 1992; Leydersdorf, 2008; Luan, Liu, & Wang, 2013; Marku, Castriotta, & Di Guardo, 2018; Marku & Zaitsava, 2018). Furthermore, the present work intro-

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