

Revisiting the Relationship between Information Technology Infrastructure and E-Commerce Performance: A Generativity Perspective

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Abstract

This research proposes a framework to study the relationship between enterprise IT infrastructure generativity and e-commerce performance. IT infrastructure generativity is the capacity of enterprise IT infrastructure to allow its IT and business users to make new things out of it. It is important to e-commerce companies because e-commerce performance is mainly driven by IT-based innovations. Organizational generativity, which is conceptualized as a three-dimensional concept consisting of simple structure, innovation culture and strategic flexibility, is proposed to complement IT infrastructure generativity to enhance e-commerce company innovations and performance. Survey method will be adopted to empirically validate the framework, and a sample of 250 internet retailers from North America will be collected. This research intends to renew our understanding of the relationship between IT infrastructure and e-commerce performance from the IT generativity perspective.

Keywords

IT infrastructure generativity, organizational generativity, e-commerce performance

Introduction

IT infrastructure is the existing installed base of a company's IT assets. It includes IT components such as hardware, software, networks, database and data warehouse that supports BI applications and data analytics, and non-IT components such as IT policies, procedures, and IT people and their skills. Enterprise IT infrastructure differs in generativity, which is the capacity of IT infrastructure to allow its IT and business users to make new things out of it, things the designers never anticipated (Zittrain 2006; 2009). Factors contributing the generativity of IT infrastructure include system development methods such as agile development, flexible IT management practices, and IT architecture (i.e., layered modularized IT architecture), etc.

Enterprise IT infrastructure generativity is important for e-commerce companies which mainly compete based on innovations. E-commerce companies' products are mainly consumer-facing IT products, such as mobile apps and website functionalities. Constant product innovations are required in order to keep up with the competition. Both the early cases such as the e-commerce in United Parcel Services (UPS) (Weill 2001) and recent cases such as Norwegian Corp, an international airline carrier (Henfridsson and Bygstad 2013), indicate the importance of IT infrastructure generativity. It enables e-commerce companies not only to develop and renew IT products for its own online transactions, but also to seek for out of the box business opportunities based on the data and the customer base accumulated through online transactions.

However, the existing research on e-commerce has not studied the role of IT infrastructure generativity in enabling e-commerce performance. Our literature review shows that the existing literature has paid full attention to the importance of IT infrastructure in e-commerce companies' operation, but mainly takes static approaches that either link specific IT infrastructure assets to specific e-commerce

business models (Weill and Vitale 2002), or consider IT infrastructure complementary to e-commerce functional capabilities in enhancing e-commerce performance (Zhu et al. 2004). Such static approaches can help us understand the IT requirements for either e-commerce in general or a specific business model at a specific period of time, but is limited in facilitating our understanding of the nature of e-commerce performance driven by continuous innovations, and the requirements for IT infrastructure to support innovations that are mainly IT driven.

In this research, we try to fulfill this research gap by adapting the concept of IT generativity to study enterprise IT infrastructure and its relationship with e-commerce performance. Such an approach is legitimate since prior studies on IT infrastructure have already found that generativity could be a property of enterprise IT infrastructure (Henfridsson and Bygstad 2013). This research will answer the following research questions: (1) what is IT infrastructure generativity; (2) how it enables e-commerce performance? We propose that IT infrastructure generativity complements organizational generativity to enable e-commerce innovations and performance. The contributions of the research include studying e-commerce performance from an innovation perspective instead of the traditional functional capability perspective and studying the enabling role of IT infrastructure from the IT generativity perspective.

Literature Review

E-commerce and IT infrastructure

The prior literature in general confirms the impact of IT infrastructure on e-commerce performance. Zhu et al. (2004) used a TOE model to investigate the antecedents of e-commerce performance. Their survey of 612 companies concluded that among all the factors, IT infrastructure is the strongest enabler of e-commerce performance. Zhu (2004)'s analysis of 114 retailers also confirmed the strong effect of IT infrastructure in complementing e-commerce capability to enable high e-commerce performance. Weill & Vitale (2002) studied the IT infrastructure components that are important to specific categories of e-business models based on case studies of 50 e-business initiatives. However, this research stream does not specify which characteristics of IT infrastructure fit the nature of e-commerce. Most adopts a static or a contingency approach to analyze IT infrastructure. For example, in (Zhu et al. 2004)'s research, IT infrastructure is measured by the number of IT assets recorded in the Harte-Hanks database.

E-commerce performance

E-commerce performance research at the early stage focuses on defining e-commerce capability based on Resource-based View, which is the ability of a firm to offer functionalities related to e-commerce. For example, Zhu (2004) defined e-commerce capabilities as a company's strategic initiatives to use the Internet to share information, facilitate transactions, improve customer services, and strengthen supplier integration. In Aranyossy (2013), e-commerce capabilities are measured by the four-grade scale of information, transaction, interaction and customization and the functionality in a late scale is considered harder to achieve than preceding scales. To date, the conceptualization of e-commerce capabilities is static in nature, which run the risks of missing changing e-commerce practices and IT products. Aranyossy (2013) found no relationship between e-commerce capabilities and corporate performance, which can partially be attributed to the inability of the static e-commerce capability concept to reflect the dynamically changing and increasingly complicated e-commerce landscape.

Another stream of research emphasizes the role of complementary organizational capabilities. Two emerging trends are: (1) dynamic organizational capabilities are more studied than static ones. For example, Saini and Johnson (2005) confirmed that strategic flexibility is critical for superior firm performance in e-commerce. Rashidirad et al. (2014) suggested that competitive strategy and dynamic capability alignment contributes to e-business performance. (2) As the environment changes, e-commerce practices become more and more complicated, and the capabilities required are increasingly dynamic, involving multiple resources and players and new organizing logics. For example, Cui and Pan (2015)'s case study suggested that as the e-commerce company grows, the business model changes, and the organizational capabilities required also change from the capability for sensing and responding in the call center stage, to the capability for cooperating in the online store stage, and then to the capability for innovating in the online and offline integration stage. Tan et al (2010)'s case study showed that with the evolution of e-commerce, firm strategic logics also evolve from the logic of positioning by competing

through unique strategic positioning, to the logic of leverage through selecting and developing strategic resources and capabilities, and then to the logic of strategy as “simple rules” and hyper-competition through continuous innovations and relentless competitive actions.

Generativity

Generativity is the capacity of some technologies to allow its users to make new things out of it (Zittrain 2006; 2009). Internet and PCs are typical examples of generative technologies. A generative technology has four characteristics. (1) **Capacity for leverage:** the technology enables valuable accomplishments that otherwise would be either impossible or not worth the effort to achieve. (2) **Adaptability:** the technology readily offers hundreds of different additional kinds of uses with or without modifications. (3) **Ease of mastery:** the technology should be easy for broad audiences both to adopt and to adapt it. (4) **Accessibility:** the technology is highly accessible in the sense that people can readily come to use and control it. The expenses of producing and adopting it are low.

The value of generativity lies in the fact that it increases the ability of users to generate new, valuable uses that are easy to distribute and are in turn sources of further innovations. Inspired by (Zittrain 2006)’s groundbreaking research, some researchers discuss the generativity of various technologies, including national or industry-wide information infrastructure (II) (Hanseth and Lyytinen 2010; Monteiro et al. 2013), Enterprise infrastructure (Henfridsson and Bygstad 2013), Platforms and ecosystems (Eaton et al. 2015), Mobile internet (Hanseth and Nielsen 2013), and BI (Kretzer 2015). Among these, II, platforms and ecosystems are the most studied technologies.

There are four streams of research on the generativity of technologies. The **first** stream focuses on making sense of and comparing the generativity of certain technologies, mostly based on (Zittrain 2006)’s four characteristics of a generative technology (Hanseth and Nielsen 2013; Monteiro et al. 2013). The **second** stream of research adopts a design science approach, and answers the question how to design a technology to make it generative (Hanseth and Lyytinen 2010). The **third** research stream specifically focuses on the balance between generativity and control. For example, Eaton et al. (2015) propose the concept of controlled generativity based on boundary resource tuning theory. The **last** stream of research studies the generative mechanisms of certain technologies. For example, several researchers investigate the micro-macro process of IT infrastructure growth based on critical realism traditions (Henfridsson and Bygstad 2013), while others study the generative mechanisms through technology affordance and options thinking lens (Kretzer 2015).

The above review highlights that generativity is a choice and a design. A traditionally closed technology such as ERP can be designed to be generative (Monteiro et al. 2013), and IT infrastructure of some companies can be more generative than others (Henfridsson and Bygstad 2013).

Research Model

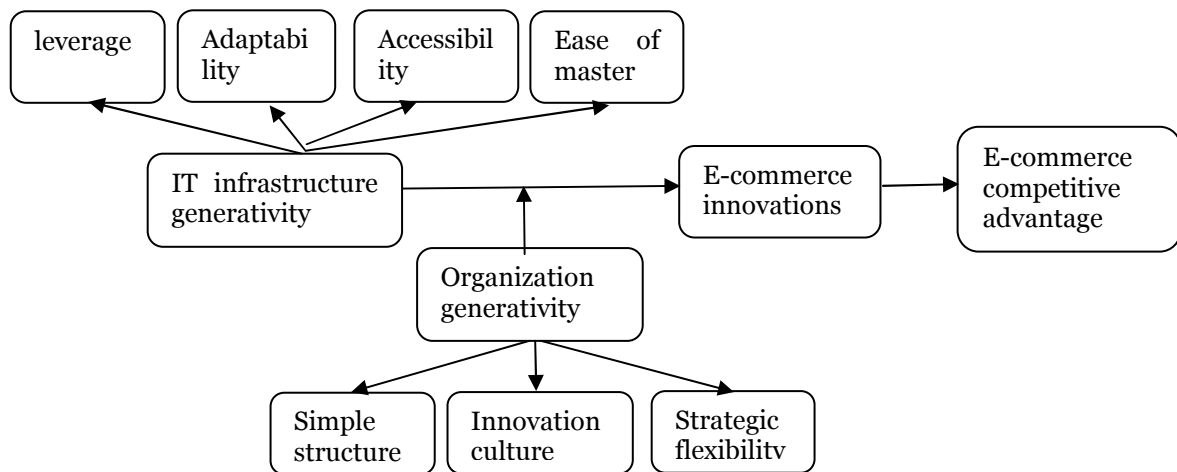


Figure 1 Theoretical Framework

Figure 1 shows the research model. First, we propose that IT infrastructure generativity contributes to the e-commerce innovations. After 15 years' development, the field of e-commerce still has not settled. New practices such as online and offline channel integration, omnichannel e-commerce, local commerce, social commerce, mobile commerce, cross-border e-commerce, and constant backend fulfillment system innovations are still evolving. Since most of the innovations and initiatives are IT based and data driven, the generativity of IT infrastructure is important since a generative IT infrastructure can cultivate an environment for e-commerce innovations and enable innovations by end-users and IT staff in major departments such as R&D, IT, sales and marketing departments since the infrastructure components are accessible, adaptable and easy to adopt. Despite that IT generativity does not guarantee the final success of an innovation, it can increase the chances of successful innovations. Thus, we propose:

Hypothesis 1: *IT infrastructure generativity is positively related to e-commerce innovations.*

A generative organizational environment complements IT infrastructure generativity to produce more IT products and innovations. The generative organizational environment construct is adapted from (Bock et al. 2012) and consists of three dimensions: innovation culture, simple structure and strategic flexibility. An organization with the above three characteristics satisfy the requirements for generativity (Zittrain 2006). They enable organizations to create value than otherwise cannot be achieved such as business model innovations (Bock et al. 2012); they are easy to manage, and allow organizations to adapt to the environment timely. In this environment, the accessibility for resources for innovation is high for employees due to the simple structure that encourages resource mobilization and coordination.

The complementarity between organizational and IT infrastructure generativity in promoting e-commerce innovations is necessitated by the blurring boundaries between IT and business, especially for generative technologies. End users can be part of enterprise IT infrastructure. For example, for data technology such as data warehouse, most of the applications are generated by end users (Watson et al. 2004). In agile development that are practiced by most e-commerce companies, users are taken into the development process periodically in short iterations. However, even if users have the potential to leverage the generative nature of IT infrastructure to create new products and services, they are unable to do so if the institutions and organizations do not encourage such activities. Therefore, we propose:

Hypothesis 2: *Organization generativity complements IT infrastructure generativity to promote e-commerce innovations*

Finally, for e-commerce companies, innovation is an important source of competitive advantage. The existing literature suggests two strategic logics on how e-commerce companies achieve competitive advantage. First, the capability logic suggests that higher e-commerce performance is enabled by building higher e-commerce capabilities (Zhu 2004). Second, the market opportunity logic suggests that firms in digital marketplaces compete by constantly launching entrepreneurial actions to capture emerging business opportunities (Sambamurthy et al. 2003; Tan et al. 2010). We follow the second strategic logic and propose that innovation is a major driver of competitive advantage for e-commerce companies because constant entrepreneurial actions in organizations are mainly enabled by innovations.

Hypothesis 3: *e-commerce innovation is positive related to e-commerce competitive advantage*

Methodology

We will use survey-based research to validate the research model. Firstly, the measurement of IT infrastructure generativity will be developed as a second order reflective scale consisting of (Zittrain 2006)'s four characteristics of generativity, and organizational generativity will be modeled as a second order reflective scale based on (Bock et al. 2012). Secondly, the data will be collected from top 1000 Internet retailers in North America, and the targeted sample size is 250. The Partial Least Square statistical method will be used to test both the measurement and structural models.

Conclusions and Contributions

This research intends to revisit the relationship between IT infrastructure and e-commerce performance by adopting a generative perspective. It intends to make the following theoretical contributions. (1) It adds the perspective of innovation to study e-commerce performance. The perspective is dynamic in

nature, which contrasts to the existing literature that focuses on static functional e-commerce capabilities (Zhu 2004). (2) It adopts the lens of generativity to study the relationship between enterprise IT infrastructure and e-commerce performance. The dominant approach in the existing literature focuses on specifying which IT infrastructure assets are important for different e-commerce business models (Weill and Vitale 2002), but this research focuses on the property of IT infrastructure - generativity that can enable and facilitate innovations. (3) It also contributes to the IT generativity literature by developing an instrument to measure enterprise IT generativity.

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