CrossMark

Predicting service industry performance using decision tree analysis

Benjamin Yeo[a],[*], Delvin Grant[b]

[a] School for New Learning, DePaul University, 1 E Jackson Blvd, Chicago, IL 60604, United States
[b] Driehaus College of Business, DePaul University, 1 E Jackson Blvd, Chicago, IL 60604, United States

ARTICLE INFO

ABSTRACT

Using global industry data on service industries from the World Bank, we investigated the impact of ICTs within the financial context, on service industry performance. This is motivated by the lack of consensus on the impact of ICTs at the industry level of analysis, and insufficient attention given to service industries. Our decision tree analysis is framed by the Technology, Organization, and Environment (TOE) framework. We discover that financial factors are better predictors than ICTs on service industry performance. Access to loans and lines of credit was the strongest predictor. It is often assumed that websites expand markets and increase revenues, but we found that they negatively affect sales revenue growth in Africa and Eastern Europe. These findings help companies and policy makers understand that ICTs alone are insufficient to improve service industry performance. Our findings lead to theoretical contributions in the form of nine hypotheses for future research.

1. Introduction

Information and communication technologies (ICTs) play a vital role in today's computer-dominated business environment in developed and developing countries. They are essential to service industries, where products and services are exclusively delivered using an online delivery method, resulting in productivity enhancements (Stare, Jaklič, & Kotnik, 2006). Service industries are heavy users of ICTs compared to manufacturing (Hempell, van Leeuwen, & van der Wiel, 2004; Stare et al., 2006). The use of ICTs make companies more competitive (Neu & Brown, 2005; Penttinen & Palmer, 2007; Shepherd & Ahmed, 2000) by adding services to their product offerings (Fang, Palmatier, & Steenkamp, 2008; Robinson, Clarke-Hill, & Clarkson, 2002). Online delivery methods are necessary for virtual companies, such as Amazon, online banks, Hotwire, Ticket Master, and Airbnb, to name a few. Business services are key drivers of economic growth (Hempell et al., 2004) that results from the development of new services and revenue streams, which improve company and industry performance. ICTs are catalysts of growth and performance, but there is a lack of impact studies on how they improve service industries (Kowalkowski, Kindström, & Gebauer, 2013) compared to manufacturing industries (Hempell et al., 2004).

ICTs are known to enable growth and development in companies, regions, and countries through the acquisition and maintenance of competitive advantages (Koivunen, Hatonen, & Valimaki, 2008), that result in improved performance, productivity, growth and other performance indicators (Bloom et al., 2010; Botello & Avella, 2014; Draca,

Sadun, & Van Reenen, 2006; OECD, 2008). In developing countries, ICTs facilitate growth in service industries, but they are not fully exploited (Stare et al., 2006). Their impact on various performance measures is inconclusive (Cecchini & Scott, 2003; Kossaï & Piget, 2014; OECD, 2008; Piget & Kossaï, 2013; Sein & Harindranath, 2004; Yeo & Grant, 2017b), particularly at the industry level (Devaraj & Kohli, 2000). Therefore, more ICT impact studies at the industry level are needed (Crowston & Myers, 2004) to develop a clearer understanding of how ICTs affect service industry performance. Impact studies benefit service industry executives by helping them to better understand how ICTs improve company operations, and policy makers benefit from understanding how ICTs affect industry structures and competition.

We adopt a broader contextual approach to analyze ICTs impact on service industry performance, because their impact is contextually driven (Yeo & Grant, 2017b). We use the Technology, Organization, and Environment (TOE) framework (Tornatzky & Fleischer, 1990) to consider the financial context in which ICTs are embedded. The strength of a financial system is critical to business performance (Beck, Demirguc-Kunt, & Maksimoic, 2005; Yeo & Grant, 2017b) and economic growth (King & Levine, 1993), so understanding ICTs in this context provides a clearer understanding of how they affect service industry performance. One challenge, applicable to information systems (IS) research, is the generation of new research hypotheses for rigorous empirical testing (Popper, 1959) that increases relevant knowledge, due to the emergent nature of ICTs, users, and organizations (Benbasat & Zmud, 1999; Osei-Bryson & Ngwenyama,2011).

We address three research gaps. The first is a lack of consistent

* Corresponding author.
E-mail addresses: benjkyeo@gmail.com (B. Yeo), dgrant2@depaul.edu (D. Grant).

findings on the impact of ICTs, particularly at the industry level (Devaraj & Kohli, 2000). The second is the lack of attention to the impact of ICTs in service industries (Kowalkowski et al., 2013); and third, the TOE framework needs more theoretical development (Baker, 2012; Zhu & Kraemer, 2005). The gaps are addressed by using a global industry dataset with a focus on service industries. With the help of the TOE framework, we are able to generate new research hypotheses for future investigations from the research findings. The new hypotheses should motivate new scientific discoveries that create new theories or falsify existing ones (Popper, 1959). Our research objective is to use a decision tree and the (TOE) Framework to investigate how ICTs and their financial context affect global service industry sales growth. The remainder of the paper is organized as follows. Section 2 is a literature review, and Section 3 comprises the research method. In Section 4, we discuss the results and the paper concludes with a discussion of the findings and limitations in Section 5.

2. Literature review

2.1. Technology, organizational, environment (TOE) framework

Within the IS discipline, our study falls under the ICTs for development (ICT4D) research area. It is a broad, inter-disciplinary area that draws theories from library and information science, communication studies, and information systems (Heeks, 2007). Heeks (2007) distinguishes theory-based, and framework-based research on a continuum. The former involves in-depth testing of grand theories, such as Structuration Theory, and the latter involves the application of frameworks that are based on multiple perspectives. The former may be restricted to theoretical discussions without practical lessons, while the latter are purely practical.

Scores of available IS research theories are at a researcher's disposal and it is their responsibility to select an appropriate one for an investigation. We use five criteria to select the theory. The first is our desire to make practical recommendations based on a strong theoretical foundation. As discussed, Heeks (2007) argued that IS research fall into a continuum of model-based and framework-based studies, where the former are based on grand theories and the latter are geared towards practical recommendations. Using this distinction, many ICT4D studies adopt an interpretive viewpoint (Lin, Kuo, & Myers, 2015) and are closer to framework-based studies. To strike a balance between this continuum of theory and practice, our adopted IS theory must be sufficiently flexible and appropriate for industry level analyses on a global scale, and yet have sufficient theoretical rigor to justify the empirical findings. The TOE framework is sufficiently flexible (Zhu & Kraemer, 2005) and has a good balance of theoretical rigor and applicability, as evidenced from previous investigations (see Angeles, 2013, 2014; Hackney, Xu, & Ranchhod, 2006; Iacovou, Benbasat, & Dexter, 1995; Ryan, Abitia, & Windsor, 2000; Yeo & Grant, 2017b; Zhu & Kraemer, 2005; Zhu, Kraemer, & Dedrick, 2004; Zhu, Kraemer, & Xu, 2006, 2003). Second, the theory should be easy to use and apply. Complicated and difficult methods and techniques are seldom used, compared to those that are easy to apply (Grant, 2016). Porter's Five Forces framework is among the most used frameworks in business studies, yet it is often criticized for its simplicity. Research methods are no different from business analysis techniques; the more difficult they are to apply, the less they are used (Grant, 2016). The TOE framework satisfies this criterion due to its flexibility (Zhu & Kraemer, 2005). Third, a global industry analysis requires a macro level theory and the TOE framework has been applied to macro level investigations (see Zhu et al., 2006, 2003). Fourth, the theory should possess the necessary constructs that are appropriate for a quantitative, empirical investigation, and fit the available data. The need to contextualize the impact of ICTs, requires our method to possess the appropriate contextual constructs that can be empirically adapted. It should possess a technology context and an environment context, both of which are represented in the TOE

framework, making it a good fit for our investigation. Lastly, the successful use of the TOE framework to investigate similar problems involving technology, organization, and the environment contexts (see Angeles, 2013, 2014; Hackney et al., 2006; Iacovou et al., 1995; Ryan et al., 2000; Yeo & Grant, 2017b; Zhu & Kraemer, 2005; Zhu et al., 2004, 2006, 2003) is a strong indicator of its appropriateness for this contextual study on the impact of ICTs.

An online wiki of the Human Behavior Project at the University of Colorado and the Information Systems PhD Preparation Program of the Marriott School of Management at Brigham Young University, provides an extensive list of more than one hundred widely used IS theories. Our selection criteria eliminate all IS theories from the list, except the TOE. There is one IS theory that is not widely used but can be considered. It is the Influence Impact Model (IIM) by Trauth (2000). The IIM posits that four societal factors – culture, infrastructure, economy, public policy – influence of the growth of the IT industry or sector, which in turn, affects the same four societal factors, suggesting that culture, infrastructure, economy, and public policy influence the IT industry, and vice versa (Trauth, 2000). However, the IIM is not as suitable as the TOE framework in this study for three reasons. First, it has not been widely used and empirically tested because it is primarily an interpretive theory. This may explain its exclusion from the online wiki of widely used IS theories. Second, it requires more modifications than the TOE to adapt to this study. Specifically, it requires the exclusion of two constructs, public policy and culture, which are not part of our research scope. Third, the infrastructure context includes human infrastructure and technical infrastructure. Human infrastructure is beyond our research scope.

We adapt the TOE framework (Fig. 1) to this study and it illustrates that the technology, organization, and environment contexts, affect company decision making. Technology comprises new and existing technologies that are leveraged by companies. Organization includes company size, scope, organizational structure, as well as formal and informal managerial and communication processes. The environment includes competitors, industry characteristics, governments and their concomitant regulations, and industry structure (Tornatzky & Fleischer, 1990). The Framework is flexible, enabling researchers to apply it to a wide range of context-driven phenomenon (Zhu & Kraemer, 2005), and Chau and Tam (1997) urged scholars to extend its use to other problem domains.

The flexibility of the TOE framework has been demonstrated in empirical research (Baker, 2012), both qualitatively and quantitatively. Pertaining to the former, it has been used in case studies to explain how Electronic Data Interchange (EDI) adoption is influenced by TOE factors (Iacovou et al., 1995), to study web services in five U.K. companies (Hackney et al., 2006), and to discuss knowledge management technologies adoption in the US, Japan, and Mexican companies (Ryan et al., 2000). Recently, Angeles (2013) used it to investigate the use of radio frequency identification (RFID) in green supply chains at Hewlett Packard, and to discuss the implementation of an environmental management information system (MIS) to support Nike's sustainability goals (Angeles, 2014). It has been used in quantitative studies to investigate e-business innovation assimilation of companies in 10 countries (Zhu et al., 2006), to identify drivers and inhibitors of e-business adoption decisions in European companies (Zhu et al., 2003), and to study the role of technology, organization, and the environment in e-business performance of financial companies (Zhu et al., 2004). It has also been used to study the influence of e-business usage in the retail industry (Zhu & Kraemer, 2005), illustrating its versatility in different domains. Its versatility enables us to operationalize ICTs as the technology context, and financial variables as the external environment context of the study, because the impact of ICTs is context-driven (Kossaï & Piget, 2014; Yeo & Grant, 2017b). Based on the typology of IS theories (Gregor, 2006), the TOE is an explanatory theory (Yeo & Grant, 2017b), but its empirical and predictive application in this study illustrates its explanatory and predictive capabilities, thus enhancing its theoretical rigor in ICT research.