



# A global perspective on tech investment, financing, and ICT on manufacturing and service industry performance

Delvin Grant<sup>a</sup>, Benjamin Yeo<sup>b,\*</sup>

<sup>a</sup> Driehaus College of Business, DePaul University, 1 E Jackson Blvd, Chicago, IL 60604, United States

<sup>b</sup> School for New Learning, DePaul University, 1 E Jackson Blvd, Chicago, IL 60604, United States



## ARTICLE INFO

### Keywords:

Tech investment  
Decision tree induction  
Clustering  
Firm performance  
ICT

## ABSTRACT

We investigate the influence of manufacturing and service technology investments (i.e., tech investments), Information and Communication Technologies (ICT), and financial factors on global manufacturing and service industry performance, from 2006 to 2014. This is accomplished by employing clustering, and decision tree induction, in conjunction with the Technology, Organization, and Environment framework (TOE) as the theoretical framework of the investigation. ICT and financial factors vary in importance across industries at different levels of technological advancement. Low-tech industries rely on loans and tech investments. As they move to transition industries, tech investments are more important. Once they become highly technologically advanced, bank lending policies become more important.

## 1. Introduction

Manufacturing and service tech investments, cover a wide variety of technologies, referred to as ICT in this study. The former include flexible manufacturing systems (FMS), computer aided design (CAD), computer aided engineering (CAE), computer aided manufacturing (CAM), computer-controlled machines (CNC), bill of materials (BOM), customer relationship management (CRM), supply chain management (SCM), and just-in-time (JIT) systems; the latter include information and communication technologies (ICT) such as computer hardware and software, networking, telecommunications, CRM, ERP, cloud computing, and SCM systems. Companies invest in manufacturing (Meliciani, 2000; Vranakis & Chatzoglou, 2011) or service technologies (Huang, Ou, Chen, & Lin, 2006; Lee, Choi, Lee, Min, & Lee, 2016) to improve performance. Questions persist on how ICT impact performance (Huang et al., 2006; Lee et al., 2016; Vranakis & Chatzoglou, 2011), despite claims that they improve firm performance (Kossai & Piget, 2014), economic growth and development (OECD, 2008), alter industry structures (Crowston & Myers, 2004), enable globalization (OECD, 2008), and other performance measures (Bloom et al., 2010; Botello & Pedraza Avella, 2014; Draca, Sadun, & Van Reenen, 2006; Vranakis & Chatzoglou, 2011). Tech investments are further motivated to improve performance (Koivunen, Hatonen, & Valimaki, 2008) by reducing transaction costs, inventory and cycle times, product quality, increasing flexibility, efficiency, productivity, and economic growth

(OECD, 2008; Vranakis & Chatzoglou, 2011). The technology paradox has diminished the effectiveness of ICT and stems from an inability to effectively measure the complexity of tech investment impact on performance (Richard, Devinney, Yip, & Johnson, 2009). ICT do not impact performance (Ho, Wu, & Xu, 2011; Motiwalla, Khan, & Xu, 2005), but several studies show they do (Huang et al., 2006; Kleis, Chwelos, Ramirez, & Cockburn, 2012; Mithas & Rust, 2016; Pakko, 2002).

The effect of ICT investments and capability on performance (Piget & Kossai, 2013; Sein & Harindranath, 2004), and the lack of industry level research (Crowston & Myers, 2004), suggest more research is needed. ICT investment studies exist at the company (Mithas & Rust, 2016), industry (Devaraj & Kohli, 2000), and country levels (Indjikian & Siegel, 2005), but the technology paradox raises concerns about such investments, particularly at the industry level (Abdi, 2008; Sabherwal & Jeyaraj, 2015). Past studies illustrate ICT investment, financial factors, and ICT capability improve performance, but the combined effect has not been extensively studied. High levels of ICT investment and strategies (Mithas & Rust, 2016), as well as financial factors (Park, Kim, & Kim, 2017), and ICT capability, improve performance (Yeo & Grant, 2017a, 2017b). Financial factors such as bank lending affect industry performance and growth (Obamuyi, Edun, & Kayode, 2012; Spring, Hughes, Mason, & McCaffrey, 2017). Hence, Huang et al. (2006) recommend investigating how ICT investment, financial factors, and ICT capability affect performance. Relationships between technological advancement levels and performance exist (cf. Bloom et al., 2010;

\* Corresponding author.

E-mail addresses: [dgrant2@depaul.edu](mailto:dgrant2@depaul.edu) (D. Grant), [benjkyeo@gmail.com](mailto:benjkyeo@gmail.com) (B. Yeo).

Botello & Pedraza Avella, 2014; Draca et al., 2006; Kossai & Piget, 2014), but as this line of research is underdeveloped, these issues motivate our RQ: How do tech investments, ICT use, and financial factors influence global industry performance across industries with different levels of technological advancement?

Currently, research findings on the impact of ICT are incomplete (Schryen, 2013). They are better interpreted when ICT contexts are considered (Torero & Von Braun, 2006). We believe that ignoring them contribute to the fragmented findings on technology performance. ICT effectiveness in one context may not be replicated in others (Ko & Osei-Bryson, 2004). Therefore, Karanasios (2014) recommends rigorous research methods to interpret research findings. We use the Technology, Organization, Environment (TOE) framework (Tornatzky & Fleischer, 1990) to discuss the impact of technology, fixed asset investment, that serves as the organization context, and financial factors, as the environment context on industry performance. Clustering is used to group industries according to their levels of technological advancement. The theoretical research contributions to the extant literature are: (1) Different levels of technological advancement have different levels of ICT use, ICT investment, and financing; (2) Industry performance varies across levels of technological advancement, and influences ICT investment decisions; (3) Tech investments become increasingly important with higher levels of technological advancement, and help identify tradeoffs between tech investments, and levels of technological advancement. The paper is organized as follows, Section 2 is a literature review of tech investments, ICT performance measures, TOE framework, and ICT contexts relevant to the study. Section 3 is the research method, Section 4 covers the results, and we conclude the paper with a discussion of our findings in Section 5.

## 2. Literature review

Section 2.1 discusses tech investments, Section 2.2 ICT performance measures, Section 2.3 the TOE framework, and Section 2.4 the two ICT contexts relevant to the study.

### 2.1. Technology investments

Manufacturing tech investments (Meliciani, 2000; Pakko, 2002; Vranakis & Chatzoglou, 2011) and service tech investments (Huang et al., 2006; Lee et al., 2016) positively influence performance, but companies question their effect on performance (Lee et al., 2016; Vranakis & Chatzoglou, 2011). Technology investments refer to the procurement of IT, which provide long term benefits and can be evaluated based on their costs and benefits (Apostolopoulos & Pramataris, 1997). There are several ways to measure performance, including company market value (Im, Dow, & Grover, 2001), increased sales, revenue, product and service quality, growth, competitiveness, customer relations, partnerships, operational efficiency, profit, return on sales, market share (Campbell, 2012; Kwon, 2007; Liao, Wang, Wang, & Tu, 2015), and product quality, response time, relationship with clients or suppliers (José Tarí, 2005; Kannan & Tan, 2005). Tech investments have been studied at the company (Im et al., 2001; Mithas & Rust, 2016; Pakko, 2002), industry (Abdi, 2008; Devaraj & Kohli, 2000), and country levels (Indjikian & Siegel, 2005; Spring et al., 2017; Vranakis & Chatzoglou, 2011). There are three factors that lead to the technology investment paradox. First, there is a debate on the ability of tech investments to improve performance. Studies show that there is no impact of tech investments on company performance (Ho et al., 2011; Motiwalla et al., 2005), but Huang et al. (2006) and Im et al. (2001) disagree. The second relates to the complexity of measuring the impact of tech investments (Richard et al., 2009), which is often measured as a single factor, but should be measured as multiple components, and broken down into basic infrastructure, wireless, data center, and collaboration (Lee et al., 2016). Brynjolfsson and Hitt (2003) argue that measuring ICT capabilities requires a more accurate view of ICT and

organizational complementarity of the systems and practices they support. This is consistent with Indjikian and Siegel (2005), who find that complementary tech investments related to labor and the IT-support work environment, increase productivity. Third, tech investments payoffs require companies to first improve their IT-enabled intangible assets, and their human ICT capability (Huang et al., 2006), and performance is contingent on the knowledge characteristics of companies (Liu, Yeung, Lo, & Cheng, 2014). These explain why companies are unable to fully exploit advanced manufacturing and ICT capabilities (Das & Narasimhan, 2001).

Kwon (2007) finds a positive relationship between tech investments and five company performance variables: growth, competitiveness, customer relationship, external partnerships, and operational efficiency. Kleis et al. (2012) find that a 10% increase in tech investments is associated with a 1.7% increase in innovation output. Santhanam and Hartono (2003) find that companies with effective ICT capabilities achieve better financial performance than those with ineffective ones. In banking, tech investments are positively related to company performance (Byrd, Lewis, & Bryan, 2006), and Indjikian and Siegel (2005) find a positive relationship between tech investments and economic performance in developing and developed countries. According to Jung (2009), high capability online brokerage companies invest more in ICT and achieve better financial performance by providing better quality customer service. ICT investments influence organizational performance (Ramdani, 2012) and create new business opportunities (Weill & Ross, 2004).

Im et al. (2001) use data from 238 companies to investigate the response to price and trading volume on ICT investment announcement and the effect of ICT investments to increase company market value over time. They find that the impact of tech investments is the same between financial and non-financial companies and ICT do not increase market value. Mithas and Rust (2016) investigate information technology strategies, tech investments, and company performances of over 300 U.S. companies. They find that companies with low levels of tech investments need to choose between revenue expansion and cost reduction. However, at higher tech investment levels, dual-emphases on ICT strategy or ICT strategic ambidexterity increasingly pays off.

### 2.2. ICT performance measures

Global industry performance can be measured in several ways, such as return on assets (Liu et al., 2014), school performance (Marks & Printy, 2003), sales and profit (Botello & Avella, 2014), turnover and profitability (Koellinger, 2006), firm profitability (Kossai & Piget, 2014), employee wages (Audretsch, van Leeuwen, Menkveld, & Thurik, 2001), industry sales growth (Yeo & Grant, 2017b), economic growth, jobs, and service (World Bank, 2016), trade (Bankole, Osei-Bryson, & Brown, 2015), capacity utilization (Yeo & Grant, 2017a), quality, operations strategy and flexibility (Arias Aranda, 2003), buyer-supplier relationships (Carr & Pearson, 1999), quality management (Kaynak, 2003; Sila & Ebrahimpour, 2005), and others (Lind, Sepúlveda, & Nuñez, 2000). ICT performance effectiveness depends on contextual factors such as manufacturing infrastructure (Archibugi & Coco, 2004), a capable workforce, country infrastructure (Bankole et al., 2015; Bollou, 2006; Henderson, 2002; Tan, Ng, & Jiang, 2018), ICT usage patterns (Zhang, Li, Qiao, Zhou, & Shen, 2018), and financial institutions' lending practices (Obamuyi et al., 2012; Yeo & Grant, 2017b). Performance has also been investigated from social, economic, financial, non-financial, micro, and macro perspectives, which are beyond our research scope. Our research scope is limited to how financial factors, ICT, and tech investments affect sales performance.

### 2.3. The Technology, Organizational, and Environment (TOE) framework

There are three reasons for using the TOE framework (Fig. 1). First, the TOE framework is a contextual theory. Given incomplete research

Download English Version:

<https://daneshyari.com/en/article/7428937>

Download Persian Version:

<https://daneshyari.com/article/7428937>

[Daneshyari.com](https://daneshyari.com)