

# Digital Innovation: A Frugal Ecosystem Perspective

Completed Research Paper

**Suchit Ahuja**

Smith School of Business  
Queen's University, Canada  
suchit.ahuja@queensu.ca

**Yolande E. Chan**

Smith School of Business  
Queen's University, Canada  
ychan@queensu.ca

## Abstract

*In this conceptual paper, we attempt to answer the question: How do firms develop frugal IT capabilities in a resource-constrained ecosystem? Frugal firms can successfully overcome severe infrastructure, financial, social, and technological constraints. "Frugal IT Innovation" is a special case of frugal innovation where IT/IS play a pivotal, core role in enabling capabilities to overcome challenges of resource-constrained business environments. It is centered on development of products/services with a sharp focus on affordability, simplicity, and sustainability. Taking a digital ecodynamics perspective, we focus on the co-evolution of firm-level capabilities, the frugal ecosystem, and underlying IT systems to uncover how a dynamic, higher-order, "frugal IT innovation capability" (FITIC) drives firm performance. Due to unique ecosystem conditions, we assess firm performance by including social and environmental measures in addition to financial measures. The paper discusses ecosystem-wide implications and contributes to advancement of both theoretical and practice-based knowledge in this domain.*

**Keywords:** Frugal Innovation, IT-enabled Innovation, Digital capabilities, Frugal IT innovation capability, Digital platforms, Platform ecosystem, Technology business incubators

## Introduction

*"Long practiced in emerging economies out of sheer necessity, frugal innovation is now becoming a strategic business imperative in developed economies, where consumers demand affordable and sustainable products. No business leader in the 21<sup>st</sup> century can ignore this paradigm shift." -Carlos Ghosn, Chairman and CEO, Renault-Nissan Alliance (Radjou and Prabhu 2015, p. 1).*

Frugal innovation is an emerging paradigm of innovation, mainly practiced in developing countries such as India, China, Brazil, and Kenya (Radjou and Prabhu 2015). In emerging economies, firms that practice frugal innovation are better able to successfully overcome infrastructure, financial, social, and technological constraints. They achieve this by focusing on products and services that are centered on affordability, simplicity, and sustainability (Agnihotri 2015; Mundim, Sharma, Arora, and McManus 2012; Varadarajan 2011). These affordable, low-cost products offer value-conscious customers from emerging markets, higher price-to-performance ratios, i.e., for a given price, the value created is higher than existing solutions (Agnihotri 2015). Although the reduced cost of production (for the firm) and reduced purchase price for the customer are hallmarks of frugal innovation, it also has other distinctive underlying characteristics, particularly with respect to contextual factors and environmental complexities (Agnihotri 2015; Mundim et al. 2012; Radjou and Prabhu 2015). Frugal firms develop business, technology, and social innovation capabilities in order to overcome difficult business environment constraints.

Some previous studies have highlighted the important, enabling role that IT/IS plays in the development of frugal innovation capabilities (Ahuja and Chan 2014a, 2014b; Sahay and Walsham 2014; Watson, Kunene, and Islam 2013). We argue that “frugal IT innovation” is a special case of frugal innovation where IT/IS play a pivotal, core role in enabling capabilities to overcome challenges of a resource-constrained business environment. An example of this type of innovation can be observed in the M-PESA mobile payment service that was developed in Kenya to overcome the lack of physical banking branches. Using a simple SMS-based transaction system, people use their mobile phones to send and receive digital currency. The affordability, scalability, and simplicity of M-PESA has made it so successful that 75% of the Kenyan population uses it today and over 30% of Kenyan GDP flows through this system (Orlikowski and Barrett 2014). Although frugal IT innovation rarely takes place within the boundaries of a single firm and is dependent upon several environmental factors for its success, most of the extant literature focuses on a single focal firm and its internal and external processes.

In this conceptual paper, we address this gap by exploring frugal IT innovation from the perspective of an ecosystem within which frugal IT firms are known to operate. We focus on the co-evolution of firm-level capabilities, the business environment, and underlying IT systems to uncover how these constructs drive firm performance. Moreover, due to unique environmental conditions we broaden how we assess firm performance by including social and environmental measures in addition to financial measures.

We use the extant literature on IT-enabled innovation (Tanriverdi, Rai, and Venkatraman 2010), digital ecodynamics – including dynamic capabilities, IT systems, and turbulent business environments (El Sawy et al. 2010) – and innovation ecosystems (Iansiti and Levien 2004; Moore 1993) to build our conceptual research model. We focus on unique characteristics of a frugal ecosystem as well as a higher-order dynamic capability that we call “Frugal IT Innovation Capability” (FITIC) and describe its underlying dimensions and theoretical underpinnings. We then discuss important constructs within the IT-enabled “frugal ecosystem” of interest, namely resource constraints, digital platforms, and technology business incubators (TBIs). In order to develop our propositions and inter-relate our constructs, we borrow from the literature on contingent resource-based theory (CRBT), theory of constraints, and theory of corporate frugality. With this research, we attempt to answer the question: *How do firms develop frugal IT capabilities in a resource-constrained ecosystem?* We begin with a review of the literature on frugal IT innovation and frugal ecosystems. Then we examine the theoretical foundations and develop our research model and propositions. Finally, we present the study’s limitations and contributions.

## Literature Review and Theoretical Foundations

### *The Frugal Ecosystem*

A business ecosystem is defined as “an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Participation in the ecosystem enables members to move toward shared visions to align their investments, and to find mutually supportive roles.” (Moore 1993). Frugal environments are known to be difficult for normal business operations, and arguably even more difficult for innovation. If firms plan to innovate in such environments, they must address prevalent resource constraints and institutional voids. While constraints represent shortages and limitations to resources and infrastructure, institutional voids characterize the absence of intermediary institutions, flawed regulatory systems, and weak contract-enforcing mechanisms (Bhatti 2012; Khanna, Palepu, and Sinha 2005). We define a frugal ecosystem as one that is characterized by significant institutional voids and resource constraints, but where the collective relational connections of the ecosystem participants are channeled towards developing affordable and sustainable solutions to fill institutional voids and overcome constraints (Costello, Donnellan, and Curley 2013). It is important to note that firms do not operate in isolation and several other entities participate in a frugal ecosystem. These may include the focal firm, its suppliers, its extended network of customers and vendors, government agencies, business support services, logistics and delivery providers, alliance partners, and often even rival firms.

Here, we present an “ecosystem” view from a digital perspective (El Sawy and Pereira 2013) as this is the ecosystem of interest for this paper. We discuss below frugal ecosystem elements: resource constraints, digital elements and TBIs. We also note that there may be different types of frugal ecosystems, including

ones that are not reliant on digital or information technologies, but those are beyond the scope of this paper. Products, services, and processes in those ecosystems may be rudimentary and heavily dependent on physical exchange of goods and services rather than being driven by digital technologies. We are focused on the frugal ecosystem of interest, one where value creation is primarily achieved by leveraging digital technologies. For this reason also, we focus on startup ecosystems with TBIs.

### Resource Constraints

For firms in emerging economies and in certain areas of developed economies, limited availability of and access to resources are significant problems which negatively affect innovation and performance; so firms need to adapt and develop frugal innovation capabilities. *Business constraints* represent the challenges of the general business environment that a firm encounters. In emerging markets, institutional voids, corruption, unclear taxation, flawed regulations, etc. are often cited as business constraints (Fjeldstad, Kolstad, and Nygaard 2006). Let us consider the example of a healthcare IT startup in India. Because, healthcare is a fragmented industry and the regulations as well as the structure of the industry are not strictly defined by the Indian government (along with missing institutional mechanisms such as universal health insurance, etc.), the introduction of IT-based solutions such as electronic health records is very challenging. Healthcare IT startups often have to perform a number of additional checks and balances and address regulatory as well as administrative ambiguities in order to gain access to clients.

*Technology constraints* represent the lack of availability or access to a particular technology or the limited capability of the available technology (Paulson Gjerde et al. 2002). The lack of technology infrastructure and lack of availability of qualified, technical and managerial human resources with appropriate skills are often cited as technology constraints. *Social constraints* are representative of social issues that plague a potential market and prevent a firm from conducting its business effectively. For example, social norms and taboos may prevent the growth of a firm, the adoption of a product or service or the socio-economic environment may render a product or service unaffordable. A firm must address such social constraints in order to succeed in difficult business environments (Valor 2005).

As an example of socio-technical constraints, consider the experience of a large US-based IT services firm. In order to expand to India, it established its first office in the early 2000s in south India. As they expanded operations, they hired a number of local IT engineers and a significant number of them were female. In that part of the country, women in the workforce were traditionally not perceived to be as competitive as men and, while seeking matches for marriage, the social norm was that the grooms earn more than the brides. However, in this organization the female engineers soon started outperforming their male counterparts and were given higher salaries and quicker promotions. As a result, this caused concern in the local community and parents of these female engineers started showing up to the offices of their managers asking them to reduce their daughters' salaries and not to promote them. The problem became so intense that the VP of the firm had to start a community-wide awareness and education campaign to try to change these social norms or at least create a positive response. After months of trying and dedicating scarce human resources towards the problem, he was finally able to improve the situation.

### Digital Platforms

Digital platforms are changing the nature of business across the world. With digital platforms such as AirBnB, Uber, Google Apps, Tencent, Salesforce, Facebook Marketing, Apple's App Store, Android Play Store, etc., the way businesses connect and engage with customers, suppliers, and partners is undergoing rapid change. To overcome some frugal environment constraints, firms have moved towards the adoption of digital platforms as augmentation mechanisms to facilitate the ease of doing business. Digital platforms provide certain inherent features and IT capabilities that enable firms to innovate despite operating in difficult environments. Digital platforms are seen as open and collaborative tools that facilitate ecosystem-wide business opportunities. They *drive competitive advantage by savings in fixed costs, efficiency gains in product development through reuse of common parts and "modular designs", production of derivative products and services with limited resources, and flexibility in product/service feature designs* (Gawer and Cusumano 2014).

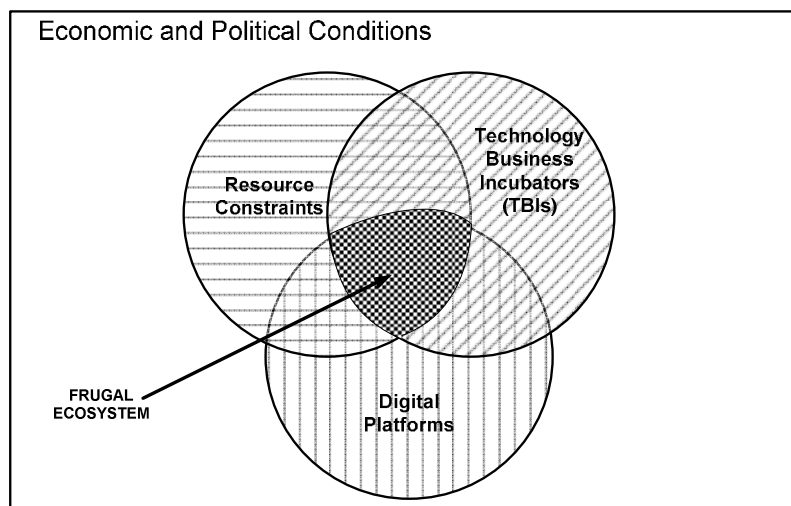
Digital platforms provide a low-cost, easy to access and easy-to-deploy solution to firms that are unable to acquire expensive digital infrastructure and other resources to compete with larger incumbents in a

variety of industries (Gawer and Cusumano 2014; Halman, Hofer, and van Vuuren 2003). This makes them a natural fit for resource-constrained environments. Although many digital platforms originated in developed markets, they are now being rapidly adopted in emerging markets (where frugal solutions are more prominent), with newer, more innovative uses. For example, JobMatch, is a jobs matching platform that has operated in India for the past 8 years. It is specifically tailored towards the informal sector<sup>1</sup> and entry-level formal sector jobs that pay less than \$250 US/month and makes jobs accessible to everyone while making hiring fast and easy. Its mission and purpose is to provide skilled aspiring workers (such as drivers, delivery personnel, nurses, beauticians, entry-level salespersons, and BPO executives for call centers.) access to better employment opportunities. JobMatch is a for-profit platform startup that is committed to bettering people's lives and providing dignified livelihoods. Its ecosystem consists of job seekers, employers, the platform itself, partner agencies that help with training and placement, and government agencies (ministries at the federal and state levels) that design and implement HR policy as well as various programs for skill development and job growth.

The full extent to which such a digital platform plays a role in frugal environments remains to be explored. This research presents an opportunity for such an exploration.

### Technology Business Incubators (TBIs)

In the extant entrepreneurship literature, technology-business incubators are known to provide infrastructure, business support, and mediation services (Bergek and Norman 2008) to startups, generally leading to better firm performance (Grimaldi and Grandi 2005). Although we are concerned with frugal environments in general, in this paper we focus on the constraints faced by young, particularly vulnerable firms, and their competitive responses. Incubation of technology businesses has become the predominant model for launching and scaling innovative businesses (Parker et al. 2015). There has been a proliferation of incubators, accelerators, innovation centers, regional innovation labs, and co-working spaces (Lalkaka 2003). This allows firms in resource-constrained environments to get access to basic infrastructure, services, and other essential resources without making large financial investments.



**Figure 1: The Frugal Ecosystem**

A typical TBI provides its clients with a comprehensive range of services, not only the rental space at an affordable price but also a full range of business and specialized services aimed intensifying technology utilization (Somsuk et al., 2012). TBIs have an established network of experts, community and government connections, and their primary task is to commercialize new technologies through innovative entrepreneurial ventures (Ayawongs et al., 2011; Somsuk et al., 2012). By studying firms that are

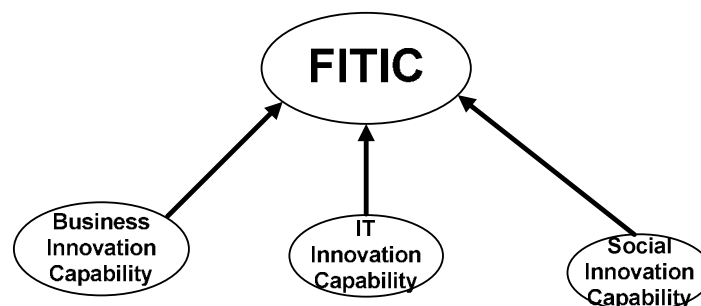
<sup>1</sup> The informal sector, informal economy, or grey economy is the part of an economy that is neither taxed, nor monitored by any form of government. Unlike the formal economy, activities of the informal economy are not included in the gross national product (GNP) and gross domestic product (GDP) of a country.

incubated within TBIs, it is easier to understand the types and characteristics of the resource constraints that the firms encounter and how the infrastructure and services provided by the TBIs helps alleviate some of those resource constraints. Hence, TBIs are an important part of the ecosystem.

It is the holistic confluence of these three factors – resource constraints, digital platforms, and TBIs – that characterizes the frugal environments we study (see Figure 1). Furthermore, our conceptualization of a “frugal ecosystem” is based on digital ecodynamics, which is a systemic phenomenon with complex interactions among the triad of environmental turbulence, dynamic capabilities, and IT systems; it does not imply that one factor is more important than another, but simply that the three factors are fused together, almost to the point of inseparability (El Sawy et al. 2010). Similarly, a frugal ecosystem emerges in tough economic and political conditions with the holistic confluence of resource constraints, digital platforms, and technology business incubators (TBIs). We recognize that there are other types of frugal ecosystems that consist of different entities, but for the purposes of this paper, the ecosystem of interest is one where these three characteristics are present, intersect with each other, and drive firms to develop frugal IT innovation capability.

### **Frugal IT Innovation Capability (FITIC)**

Frugal innovation includes product features and processes that are new to the market in terms of application, material used or the business model, and requires minimal resources, using materials that are recycled or easily replaceable (Wierenga 2015). The features of the frugal product/service have a value-adding function, instead of a price-increasing or appearance purpose. Besides considering the environment and the economic background of the consumer, the products typically improve value for the customer and have obvious social benefits (Wierenga 2015). Based on these aspects of frugal innovation, FITIC is defined as “*the capability of a firm to redesign its processes, products, and services, to minimize resource usage and increase affordability and sustainability by combining business innovation, information technology/systems innovation, and social innovation.*” The use of IT systems and services coupled with frugal innovation practices is providing firms with frugal IT innovation capabilities along with opportunities for competitive advantage and strategic differentiation (Ahuja and Chan 2014b). A number of firms have innovative, low-cost IT strategies and use cost-effective technical infrastructures, relying, for instance, on cloud-based approaches. Frugal firms often spend a larger percentage of revenue on digitization, are faster to market with new offerings, and perform better than peers in developed economies, essentially leapfrogging through rapid adoption of emerging technologies (Weill and Woerner 2013). This generally results in faster innovation and higher levels of performance. These firms may also develop strong organizational learning capabilities and knowledge management capabilities, which lower legacy costs and avoid high overhead costs (Weill and Woerner 2013).

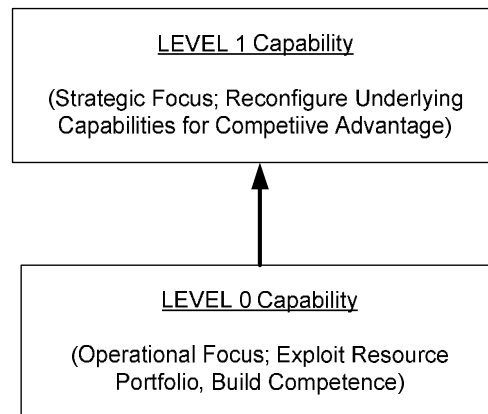


**Figure 2: Dimensions of FITIC**

Frugal IT innovation is a more specific version of frugal innovation that emphasizes the use of IT. With frugal IT innovation capability, firms additionally focus on development of capabilities for business model innovations and social innovations, which in turn provide opportunities for competitive advantage and strategic differentiation (Ahuja and Chan 2014b). Based on the extant literature (Ahuja and Chan 2014a; Ahuja and Chan 2014b; Bhatti 2012; Bhatti and Ventresca 2012), there are three dimensions of FITIC: 1) Business Innovation Capability, 2) IT Innovation Capability and 3) Social Innovation Capability (See Figure 2). Any business can focus on these three innovation capabilities, but FITIC is unique because it emphasizes all three in a frugal environment; all three dimensions together maximize the opportunity for

survival of the organization in a difficult business environment. Each dimension and its underlying foundational principles will be explained in detail below.

FITIC is a higher-order capability, also known as a “first-order” or “Level-1” capability. This is defined as a capability that can reconfigure underlying operational systems or “zero-order” capabilities (Winter, 2003). Zero-order capabilities reflect an ability to perform the basic operational activities of the firm (Pavlou and El Sawy, 2010). Therefore, to a certain extent, FITIC is driven by underlying capabilities that are dependent on IT systems and IT resources. However, these underlying capabilities are more focused on the operational and tactical level of the organization, while FITIC is a more strategic capability that can orchestrate the response of the firm in frugal business ecosystems. Figure 3 shows the difference between lower-order and higher-order capabilities. Next, we explain the underlying dimensions of FITIC.



**Figure 3: Explaining First-order Constructs**

### **Business Innovation Capability**

Business innovation capability involves redefining business models and reinventing value chains by integrating knowledge into the business processes for continuous improvement. This can be done by disrupting traditional business models and established value chains, ecosystems, and alliance networks of competitors or by establishing entirely new ones. We propose that it has two dimensions (see Figure 4):

1) Business Model Innovation Capability is defined as reconfiguration of the underlying components of business models, i.e., processes, profit formulas, value propositions, and resources, in order to expand or establish new revenue streams (Chesbrough 2010; Eager et al. 2011; Hwang and Christensen 2008). To find the right fit between the value proposition and perceived consumer value, frugal firms need to focus on the entire business model. In the literature on business model innovation (Giessmann and Stanoevska-Slabeva 2012; Osterwalder, Pigneur, and Tucci 2005; Rosca et al. 2016) there are five main building blocks: 1) Customer Segment, 2) Value Proposition, 3) Customer Relationship, 4) Channel, and 5) Revenue Stream. Table 1 provides details on how each element of the business model relates to FITIC.

2) Absorptive Capacity (Liu, Ke, Wei and Hua 2013; Zahra and George 2002) is the “ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal 1990, p. 128). This involves acquiring, assimilating, transforming and exploiting knowledge (Overby, Bharadwaj, and Sambamurthy 2006; Zahra and George 2002). In frugal environments, firms compensate for their lack of resources by relying heavily on their internal and external knowledge and learning capabilities, as they constantly seek to drive value for customers and profitability for shareholders (Ahuja and Chan, 2014b; Santos and Williamson, 2015).

Thus knowledge plays a key role in driving performance in a dynamic and highly competitive environment. Firms that deploy IT systems and possess superior knowledge management capabilities tend to retain and re-use collective organizational knowledge, thereby developing better innovative capabilities (Alavi and Leidner 2001; Borghoff and Pareschi 1998; Gallupe 2001; Holsapple 2004; Nevo and Chan 2007; Sabherwal and Sabherwal 2005; Tanriverdi 2005).

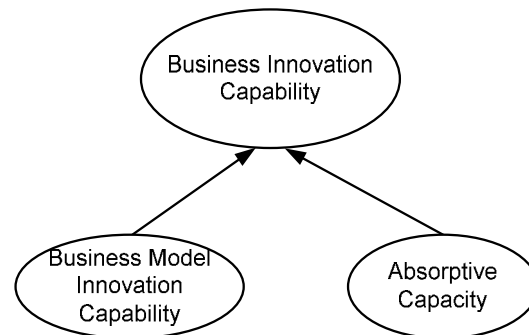
<b>Building Block</b>	<b>Description</b>	<b>Relevance to FITIC</b>
Customer Segment	Describes the segments of customers a company wants to offer value to	The popularity of big data analytics and business intelligence for gaining valuable customer insights is well known. With FITIC, a firm gains the ability to focus on a specific segment of customers (in both emerging and developed markets). These customers are generally value-conscious, price-sensitive, and tend to aggressively look for the right product/service features at the right price
Value Proposition	Refers to the benefit offered by the product or service offered. It is viewed in terms of three aspects: economic, social and environmental value	Through FITIC, firms can improve their value proposition and align it with customer requirements. Key features include: affordability, good-enough products and services, basic functionality, frugal use of resources, maximized value with reduced nonessential costs, reduced total ownership cost with low initial investment and low maintenance and repair (Tiwari and Herstatt, 2012; Tiwari et al., 2014)
Customer Relationship	Explains the kind of links a company establishes between itself and its different customer segments	Using the digital communication media available through FITIC (such as social media and mobility) firms can engage customers that have high price sensitivity, high volume orientation, high product/service feature awareness, etc. Furthermore, the use of social media and mobility can lead to better education of customers and even benefit some of the value chain actors. For example, micro-finance services may be provided so that customers can afford to pay
Channel	Describes the various means of the company to get in touch with its customers	Use of digital, mobile, and social media to enhance customer experience, build local capacity, and involve Bottom of the Pyramid (BOP) markets in the value chain as suppliers, distributors, producers and service providers, local suppliers, nontraditional supply chains, and alliances with local non-conventional partners
Revenue Stream	Describes the way a company makes money through a variety of revenue flows	Low price, no frills structure, low capital intensity, limited use of resources, reuse of existing components, ease of use and cutting edge technology (Rao, 2013)

**Table 1: How FITIC relates with each Building Block of the Business Model**

Tencent, which is a mobile software development firm in China, famous for its WeChat and QQ messenger platforms, presents a good example of business innovation capability. Instead of following the business model of its competitors, which was based on advertising revenue, Tencent built a new, innovative business model by using micro-transactions (typically less than a dollar in price), such as charging consumers to upgrade the look of the avatar that appears on their chat service. Additionally, Tencent created new ways of bringing low-cost games and emoticons to price-sensitive but bored young consumers throughout Asia (Clark and Babson 2014). By launching a ‘freemium’ model, where gamers choose to pay to enhance their characters, Tencent was able to crack the piracy problem in Asia, by turning the games into thriving online communities. This resulted in much higher revenues and greater customer growth than its rivals in the US and Europe. Not surprisingly, Tencent currently gains 80% of its approximately \$7 billion revenue from value-added services.

With respect to absorptive capacity in frugal ecosystems, understanding the contextual parameters that are used for decision-making by all actors (within and outside the ecosystem) can prove to be very helpful for apportioning and delivering greater value throughout the ecosystem. This type of “contextual intelligence” (Khanna 2014), is necessary in order to drive competitive advantage. A firm can sense and respond to ecosystem needs based on its contextual intelligence and may or may not use IT tools to

gather, analyze, and act on this intelligence. Frugal firms may be reliant on their customer representatives in the field or may build a sensing capability within the digital platform to respond to changes in the ecosystem. For example, the Uber digital platform is equipped to collect feedback from both drivers and riders and this data helps to understand ecosystem-level changes.



**Figure 4: Dimensions of the Business Innovation Capability Construct**

### IT Innovation Capability

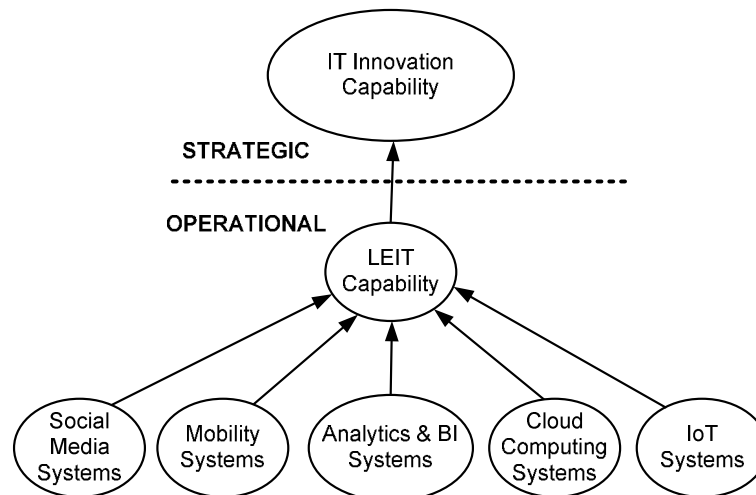
Disruptive technologies are simpler, cheaper, more reliable, and convenient than existing ones (Christensen 2013). It is within this general framework that most frugal technology innovations take place, although not all frugal innovations are disruptive and not all disruptive innovations are frugal (Wierenga 2015). It is also important to note that frugal technology innovations are generally not about creating the next radical technology product or service, but instead about finding the right fit between the needs of the market and the technical specifications of the product (Heeks 2012).

With respect to FITIC, the “technology” aspect or dimension is more focused on IT instead of other technologies. This is where cutting-edge IT systems and other emerging technologies play a crucial role. In frugal contexts, IT plays a dual role. IT systems must be able to provide the support required to enable firms to remain competitive, while at the same time ensuring that IT investments do not negatively affect the firm’s cost and process efficiencies (Ahuja and Chan 2014b). As a result, instead of investing heavily in IT infrastructure, frugal firms – particularly small firms and startups – focus on leveraging SMACIT - Social media, Mobile computing, Analytics and business intelligence, Cloud computing and the Internet of Things (Ross 2014) - technologies to foster innovation and lower their operational costs. With these SMACIT emerging technologies and systems, these firms are able to move expensive IT infrastructure investments “from Capex to Opex” (essentially renting instead of buying resource intensive equipment, services, and networks). As such technologies become readily available in frugal markets, firms develop the capability to exploit them to gain competitive advantage and strategically differentiate their products/services. We refer to this capability to exploit and use SMACIT systems and technologies as “Leveraging Emerging IT” (LEIT) capability. LEIT capability allows the firm to be flexible (Rivard 2004) and adaptable (Tallon 2008) with respect to the cost and usage of IT (Ahuja and Chan, 2014a, 2014b). It is similar to IT leveraging capability (Pavlou and El Sawy 2010), which has been used in a New Product Development (NPD) context and is defined as “the ability to effectively use IT functionalities to support IT-enabled NPD activities.” In frugal contexts, LEIT capability is defined as “the ability to effectively use underlying SMACIT systems and technologies to support frugal innovation.”

While IT leveraging capability is supported by more internally-oriented systems for resource management, project management, communications, and collaboration (Pavlou and El Sawy 2010), we posit that LEIT capability is built on capabilities provided by underlying SMACIT systems and technologies, and therefore focuses on both internal and external factors. In Figure 5, IT innovation capability is shown as a first-order construct. The combination or configuration of SMACIT technologies forms a “zero-order” or “Level-0” capability (LEIT). Firms will possess varying levels of each of these systems and technologies and some firms may not possess all of these technologies (especially IoT). Additionally, in the context of frugal firms, acquisition of basic IT infrastructure such as servers, hardware, enterprise software, etc. is replaced with contractual or rental SaaS, cloud storage, and mobile



apps. Therefore, these elements of SMACIT can be considered “basic resources” or “competencies” that are essential for business operations.



**Figure 5: The First-Order IT Innovation Capability Construct**

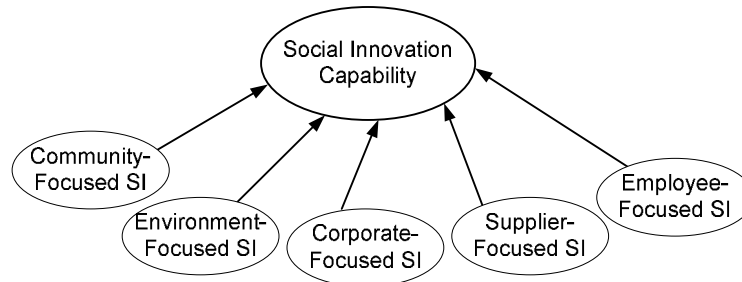
The use of SMACIT technologies is prevalent within and in support of the core digital platforms that are at the foundation of frugal ecosystems. First, the adoption of digital technologies is accelerating in developing countries. As access to these technologies becomes more affordable, firms are increasingly adopting a cloud-first, mobile-first and social media-integrated approach. This has allowed them to be competitive and in certain cases even at par with the developed world. It has resulted in faster cycles of innovation and enabled firms to strategically leverage SMACIT technologies to enhance their competitive advantage (Fong 2009).

### Social Innovation Capability

Social innovation capability can be defined as the ability of a firm to create novel solutions to social problems that are more effective, efficient, and sustainable than present solutions, and for which the value created accrues primarily to society as a whole rather than to private individuals (Stanford Center for Social Innovation 2014). Social innovation capability augments business capabilities and relationships with better use of assets and resources (Birkinshaw, Foss, and Lindenberg 2014; Caulier-Grice et al. 2012; Kanter 1999). Furthermore, social innovation is required for social progress, enabling inclusive growth and prosperity at the grassroots in an affordable and sustainable manner (Porter 2015). Social innovation has gained mainstream attention (Mintzberg 2015) with consumers demanding impact investing and social impact bonds (Liebman 2011). In frugal contexts, social innovation is projected as a step beyond mere corporate social responsibility (CSR) initiatives by making social purpose a core part of organizational strategy (Radjou and Prabhu 2015). This is helpful because organizations with CSR programs often engage in simultaneous profitability activities that tend to undermine the purpose of their CSR programs. For example, a study found that “the money, energy, and influence used to push popular CSR programs would be better spent in radically altering the way companies operate and allowing for better regulation” (Birkinshaw, Foss, and Lindenberg 2014).

Social innovation is often seen from the lens of CSR. However, “the prevailing approaches to CSR are so fragmented and so disconnected from business and strategy as to obscure many of the greatest opportunities for companies to benefit society. If, instead, corporations were to analyze their prospects for social responsibility using the same frameworks that guide their core business choices, they would discover that CSR can be much more than a cost, a constraint, or a charitable deed—it can be a source of opportunity, innovation, and competitive advantage” (Porter and Kramer 2007). Furthermore, well-known strategic thinkers are now calling for firms to engage in active social innovation, including social impact investing, social entrepreneurship, and social progress initiatives (Porter 2015). As a scientific construct, “social innovation” is still undergoing an evolution process (Nicholls, Simon, and Gabriel 2015). There are several perspectives on the measurement of social innovation which stem from research on

corporate social performance (CSP), social impact, and well-being of corporate and public stakeholders (Clarkson 1995). In addition, Clarkson (1995) also provides multiple levels of analysis that are used to measure CSP. For this study, we adapt dimensions for social innovation that are related to CSP. These dimensions span the organization's configuration of principles of social responsibility, social responsiveness, policies, and programs (Orlitzky, Schmidt, and Rynes 2003). Orlitzky et al. (2015) provide a comprehensive set of dimensions including: 1) Community-focused Social Innovation (SI), 2) Environment-focused SI, 3) Corporate-focused SI, 4) Supplier-focused SI, and 5) Employee-focused SI.



**Figure 6: The Social Innovation Capability and its Dimensions**

Community-focused SI refers primarily to the residents of local communities in which a company operates. It may also refer to the larger areas, such as a region or nation affected by a company's operations. Environment-focused SI refers to a firm's commitment toward the establishment of sound and appropriate environmental management systems, increasing efficiency in the use of resources and energy, and avoidance of harm to the environment. Corporate-focused SI refers to corporate governance, such as transparency, stock ownership structure, voting rights, and compensation paid to senior executives. Supplier-focused SI refers to a firm's outsourcing policy, code of conduct for contractors, monitoring of sub-contractors, involvement in labor rights and human rights, and overall level of coordination with its suppliers. Employee-focused SI refers to a firm's commitment towards social issues related to the company's employees, and chiefly toward health and safety, diversity, and employee involvement. Figure 6 shows the social innovation capability construct with its dimensions.

We posit that FITIC is a combination of business, technology, and social innovation capabilities which form its dimensions. Again, FITIC is a higher-order construct, along the same lines as discussed previously. Instead of being implemented individually, the three capabilities jointly form the FITIC construct, and can be calibrated and adapted by the organization for its specific strategic purposes. It must be noted that firms may possess one or more well-developed dimensions and the level or intensity of each dimension may vary. However, the most successful representation of FITIC will be seen in cases where all three dimensions are well developed.

As an example of how business, IT, and social innovation capabilities drive innovation consider the case of The Okwaho Network (<https://okwahonetwork.com>). Okwaho is a Facebook-like social network for indigenous people of North America. It offers a unique networking experience where indigenous entrepreneurs, small business owners, indigenous communities, innovators, companies, investors, service providers, organizations, students and youth can connect, engage and discover business and economic development opportunities. In order to support First Nations entrepreneurs of northern Ontario, the Okwaho Network acts as a digital platform that enables them to sell their indigenous products to a global market that is much larger than they typically could access. On the other hand, the Okwaho Network encourages businesses and individuals to join and provide support and services to the indigenous people of northern Ontario. As a result, a mutual space for exchange of goods and services exists which also acts as a medium for discussions and execution of plans for economic development of the region. The Okwaho Network is addressing challenges faced by indigenous people by developing all three dimensions of FITIC. It was started by two entrepreneurs who re-discovered their indigenous roots and then established the network through local relationships to develop contextual intelligence, and by offering value-added services that were simple and affordable. It was also able to garner government and venture capitalist support for its innovative business which impacts an untapped potential market and also addresses social challenges such as lack of infrastructure, access to larger markets, connectivity to complementary business services, and outreach to customers for indigenous people of the region.

## **The Frugal Ecosystem and FITIC**

### **Resource Constraints**

The extant literature reveals two major paradigms of innovation. The first paradigm of resource-based innovation relies on resource availability, resource acquisition, and capability development (Barney 1991; Chandler and Hanks 1994). In this paradigm, slack resources, which are resource cushions that firms can use in a discretionary manner to counter threats and exploit opportunities, are used to drive innovation (Bourgeois 1981; Cyert and March 1963). Firms invest in research and development capabilities, patent generation, and highly-skilled human resources (Acs and Audretsch 1988; Trajtenberg 1990). The second paradigm is based on resource constraints (Gibbert, Hoegl, and Valikangas 2007; Hewitt-Dundas 2006) and relies on innovating with limited or scarce resources (Li and Atuahene-Gima 2001; Rao and Drazin 2002). Interestingly, while the extant IT literature focuses heavily on resource-based innovation (Bharadwaj 2000; Wade and Hulland 2004), there are few studies on constraints-based innovation. This is where frugal environments present an opportunity for exploration of capability development for constraints-driven innovation.

It is a well-established fact that the business environment in emerging markets is difficult and access to basic infrastructure and services can be challenging (Agnihotri 2015; Prahalad and Mashelkar 2010). Hence, firms either need to find mechanisms to circumvent such constraints (Chin et al. 2015) or innovate their way out of such environments, usually by following frugal innovation practices. According to the theory of constraints (TOC; Goldratt 1997), constraints provide leverage points to the firm by bringing attention to particular weaknesses with respect to the environment that may otherwise prevent the firm from achieving its goals. Previous studies have already shown that frugal ecosystems face market constraints, resource scarcity, and institutional complexities (Bhatti 2012). We refer to these constraints collectively as “resource constraints” (Sharma and Iyer 2012). Constraints can serve as a driving factor for revitalizing the entire business model of the firm (Spector 2011). This lends support to the assertion that constraint-driven innovation should be studied in more detail. On one hand, resource constraints limit the innovation potential and performance outcomes of a firm (Gibbert et al. 2007; Hewitt-Dundas 2006). On the other hand, limited or scarce resources (Li and Atuahene-Gima 2001; Rao and Drazin 2002) often drive a firm to be more creative and foster innovation. We posit an inverted U-shaped relationship between innovation and resource constraints. To understand this relationship, we focus our investigation on business, technology, and social constraints as described earlier.

With frugal IT innovation, the focus is on using IT to address resource constraints as a part of the mainstream, strategic and competitive outlook of the firm. For example, India-based micro-irrigation firm Jain Irrigation Systems was named in Fortune magazine’s inaugural ‘Change the World’ list of companies making significant progress in addressing major problems as a part of their core business strategy. Jain Irrigation Systems developed an affordable business model and used solar-sensor technology to overcome the social challenge of providing irrigation systems to farmers with very small plots of arable land.

### **Digital Platforms**

A digital platform is defined as the components used in common across a product family (Boudreau 2007; Parker and Van Alstyne 2008) whose functionality can be extended by applications and is subject to network effects (Parker and Van Alstyne 2005; Eisenmann et. al. 2006; Evans et al., 2006). In a digital ecosystem, the platform owner and independent software vendors (ISVs) co-create the platform’s value proposition and support its market adoption. As more complementary members join the ecosystem to supply complementarities, the more valuable the platform becomes to consumers due to a greater variety of choice (Scholten and Scholten 2012).

Platforms are particularly useful in frugal ecosystems due to the resource-constrained nature of such ecosystems and the difficulties faced by firms due to prevalent business, technology, and social constraints as well as institutional voids (i.e., missing government services, lack of market information, flawed taxation and financial structures, etc.). First, a digital platform generates strong network effects (Cusumano 2011). If the platform is in use by a number of customers, vendors, and rival firms, the platform owner firm can leverage it to sense and respond to market needs and as a means of competitive intelligence in order to maintain its competitive advantages (Mugavero, Benolli, and Sabato 2015).

Second, digital platforms minimize opportunities for competitors to fragment the market through exploiting differentiation strategies or segmentation niches (Cusumano 2011). Therefore, a platform owner firm must develop IS/IT capabilities and business models around the strategic differentiators and segmentation niches that these platforms create for them. In order to remain competitive, firms must not rely only on the capabilities of the platform, but develop their internal and external business and process capabilities based on the environment and ecosystem in which the platform is deployed (Tan et al. 2015). This is where “frugal IT innovation capability” or FITIC plays a major role, as will be explored in the sections that follow.

Third, a platform makes it difficult or costly for users or ecosystem partners to use more than one platform by imposing switching costs and raising barriers to exiting the platform (Cusumano 2011). This can be achieved by making APIs available and easy to use, not imposing high fees or development charges, and providing flexibility to the platform participants. However, it is important to take these strategic initiatives while closely monitoring rival platforms and adapting tactically in response to their moves.

### **Technology Business Incubators (TBIs)**

In order to access resources and services that are typically unaffordable and expensive for a new, small firm, technology entrepreneurs in frugal ecosystems often choose to launch their startups with the help of a business incubator. TBIs help firms survive in the early stages of business operations (Hamdani 2006; Joseph, Bordt, and Hamdani 2005). Using incubator services, startup firms can avoid resource intensive investments, leverage knowledge networks and expert services, and strategically use their limited resources for pursuing business goals. According to extant entrepreneurship literature, technology business incubators (TBIs) aim explicitly at incubating enterprises with high or advanced technology content (Somsuk et al. 2012). A typical TBI provides its clients with a comprehensive range of services, not only the rental space at an affordable price but also a full range of business and specialized services aimed at intensifying technology utilization (Somsuk et al. 2012). TBIs have an established network of experts, community and government connections, and their primary task is to commercialize new technologies through innovative entrepreneurial ventures (Somsuk et al. 2012). TBIs facilitate knowledge spillovers (Amezcuca 2010), and create value by providing entrepreneurs and startup firms with resources they cannot readily afford on their own, from basic physical space to access to experts and equipment.

The primary competitive advantage for TBIs is to ensure the survival and growth of the incubated firms, especially in early phases of their lifecycle (Somsuk et al., 2012). Using the theoretical lens of RBV, TBIs can be described as possessing certain resources and capabilities that enable them to effectively support the firms which they host (Chan and Ahuja 2015; Somsuk et al. 2012). According to Somsuk et al. (2012), TBI *resources* are categorized as follows: 1) “Human Resources” refer to attributes of the founding team, the TBI’s management team and staff as well as in-house and external experts that work with the TBI. Additionally, government and industry personnel who act as partners can also fit in this category. 2) “Technological Resources” refer to the firm-specific products and technology, equipment/labs, highly specialized skill sets, technical knowledge and expertise, business experience with the technology, and intellectual property rights. 3) “Financial Resources” refer to all the different financial support that firms can use such as venture capitalists, angel investors, banking, and other debt financing organizations, and grant making entities. 4) “Organizational Resources” refer to the systems, the routines and the relationships embedded in the company (for example: accounting, finance, and legal structures and routines that the firms need to comply with). Studies have also shown that the *capabilities* of the incubators can play a role in the success of the tenant firms, especially in the case of small firms (Chan and Ahuja 2015). These capabilities include legal advising, accounting, marketing, HR management, and business executive coaching as well as access to local technical and managerial talent, government grants, etc. (Chan and Ahuja 2015). As TBIs provide important resources and capabilities to shape the business environment for frugal IT innovation, it is important to consider these resources and capabilities.

Going back to the digital ecodynamics perspective, the fused interaction among these three different elements of the frugal ecosystem ensures the coevolution of the digital strategy, IT systems, and the innovation mechanisms deployed in response by the firms. These complex and fused interactions often lead to redrawn industry boundaries, revised industry rules, new organizational forms and structures, enhanced inter-organizational reach and range, and powerful network externalities (El Sawy et al. 2010) in the frugal ecosystems. As resource constraints change over time and these changes become more

turbulent, the firms respond by developing better FITIC as well as other capabilities for supporting frugal innovation, by relying more heavily on digital platforms and TBIs for guidance. Hence the relationships among the elements of the ecosystem co-evolve with changing conditions within the ecosystem. The current proliferation of digital platforms in emerging markets as well as the growth of TBIs that support entrepreneurs in development of digital platform ecosystems provides evidence for how these relationships foster innovation.

## Developing A Conceptual Framework

In order to interrelate the frugal ecosystem, FITIC, and firm performance, we use the following theoretical lenses: 1) the theory of constraints (Goldratt 1990; Boyd, Gupta, and Sussman 2001) and literature on slack resources (Nohria and Gulati 1996) will be used to relate resource constraints to FITIC; 2) contingent resource-based theory (Brush and Artz 1999) will be used to relate digital platforms with FITIC; 3) RBV and IT-enabled innovation literature will be used to relate TBIs with FITIC; 4) for relating FITIC with firm performance, the theory of corporate frugality (Anderson and Lillis 2011) will be used. A discussion on how firm performance will be measured and its specific dimensions is also presented below.

We first begin by examining the elements within the ecosystem (i.e., resource constraints, digital platforms, and technology business incubators). Figure 7 provides the theoretical underpinnings that will be used to explain the relationships between each antecedent, environmental construct and FITIC as well as between FITIC and firm performance.

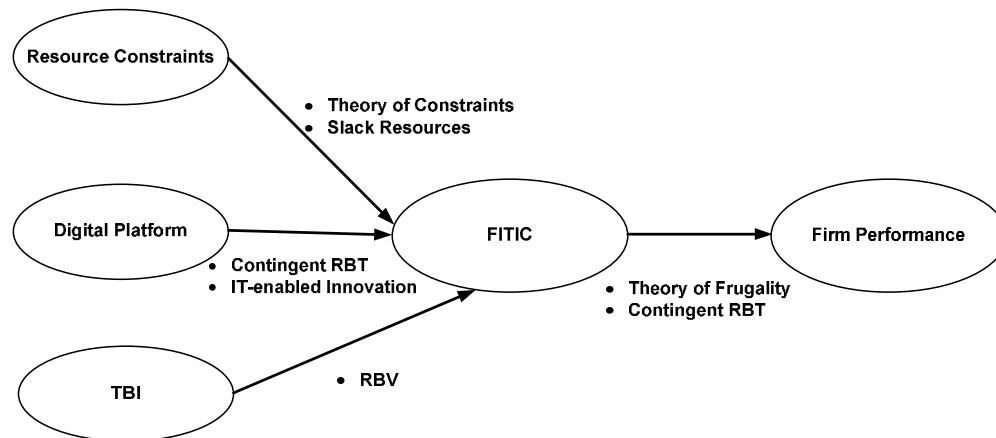


Figure 7: Theoretical Framework

### Resource Constraints and FITIC

Slack resources increase innovation-focused activities while optimizing other operational activities (Majumdar and Venkatraman 1993; Zaltman, Duncan, and Holbeck 1973). However, maintenance of slack resources can pose a challenge for efficiency of frugal firms (Leibenstein 1969). Evidence suggests that for startups and small firms operating in a complex business environments similar to frugal ecosystems, the impact of slack on performance can be more negative (George 2005).

The theory of constraints (Coman and Ronen 2007) states that under-loaded functions or departments in a firm can only take on a limited level of additional load without adding extra resources and incurring extra costs. Beyond this particular break-point level, the system is bound to fail under heavy stress. Previous research on theory of constraints provides some evidence that in addition to production efficiency, constraints often improve business process efficiency, particularly under heavy workloads with limited resources (Rhee, Cho, and Bae 2010). Additionally, each aspect of the business model can be reconfigured and reorganized to accommodate and work around resource constraints, especially in cases where the focal firm's business model is different from the business model commonly used in the specific business arena (Spector 2011). Strategic and operational agility can be enhanced while encountering severe resource constraints (Ifandoudas and Chapman 2009). By adopting a resource-based view of the business, the strategic side of agility can be achieved, while by adopting and adapting to resource

constraints, the operational side of agility can be met (Ifandoudas and Chapman 2009). This is true in frugal ecosystems too, as firms develop business innovation capability.

In the literature on slack resources, a curvilinear, inverse-U shaped relationship is shown between slack resources and innovation (Nohria and Gulati 1996). In fact, many relationships in strategic management follow an inverted U-shaped pattern, where moderate levels of a strategy lead to optimal performance (Haans, Pieters, and He 2015). Thus, using arguments from both slack resource theory and theory of constraints, we posit an inverted U-shaped relationship between constraints and FITIC:

*P1: In frugal ecosystems, as the severity of business, technology, and social constraints increases, so will the level of FITIC, but after a certain peak, FITIC will decrease steadily.*

### ***Digital Platforms and FITIC***

Contingent Resource-Based Theory (CRBT) states that the value of resources is contingent on the context in which they are exploited as well as the fit between contextual requirements, available resources and capabilities of the firm (Aragon-Correa and Sharma 2003; Brush and Artz 1999). CRBT also states that environmental uncertainty, complexity, and organizational constraints are factors that force firms to develop capabilities and exploit resources effectively for competitive advantage (Aragon-Correa and Sharma 2003). In difficult business environments, firms compete not on the basis of unique resources and capabilities, but on the basis of whether their resources and capabilities can be employed to meet customer needs (Wang et al. 2006). In the context of frugal ecosystems, firms exploit resources at their disposal by leveraging digital platforms to shape the ecosystem as well as customer behavior to their advantage (Ahuja and Chan 2016; Radjou and Prabhu 2015; Sedera et al. 2016). Furthermore, when these complementary capabilities are linked to primary resources and capabilities, they support the creation of sustainable business value (Chae et al. 2013). We posit that digital platforms provide such complementary capabilities. We discuss these below.

1) **Complementary Business Capabilities:** If the platform is in use by a number of customers, vendors, suppliers, and rival firms, the platform owner firm can leverage it to sense and respond to market needs and as a means of competitive intelligence in order to maintain its competitive advantages (Mugavero, Benolli, and Sabato 2015). This is especially useful in frugal environments where maintaining control over the ecosystem can lead to significant benefits, resource consolidation, and efficiency gains where shared services and open software modules can result in higher levels of firm performance (Ahuja and Chan 2016). Digital platforms enable complementary business model innovation capabilities by providing opportunities for multi-level innovation (Gonzalez, Ahuja, and Negi 2015) and digitized marketplaces (Geissman and Stanoevska-Slabeva 2012).

2) **Complementary IT Capabilities:** Digital platforms also enable complementary IT innovation because implementation of a digital platform leads a firm towards higher IT agility, user empowerment, resource integration, data process standardization, etc. (Richardson et al. 2014). The developmental process also enables IT/IS capabilities that provide internal and external strategic benefits to the firm with respect to its orientation and tactical moves within the ecosystem, thus directly affecting firm performance and strategic outcomes (Tan et al. 2015).

3) **Complementary Social Innovation Capabilities:** Platforms impact social performance, improve organizational communication and collaboration, and empower participants of the ecosystem (Richardson et al. 2014). Complementary innovations provided by participants within and outside the ecosystem may be provided directly to end-users (Bogers and West, 2012). While these complementary innovations may not directly involve the platform-owner firm, they do increase the perceived value of the firm's products and services for their customers, resulting in increased innovation functions (Bogers and West 2012). Digital platform capabilities can be customized for frugal ecosystems through leapfrogging, platform lightness, content localization and contextual adaptation (Ahuja and Chan 2016). So we posit:

*P2: In frugal ecosystems, use of digital platforms leads to higher levels of FITIC.*

We expect that, in frugal ecosystems, superior complementary business, technology, and social capabilities of digital platforms lead to superior FITIC.

## **TBIs and FITIC**

The resources and capabilities provided by TBIs to firms in frugal ecosystems can be viewed as complementary to the firm's capabilities and as enabling mechanisms to ensure a "good fit" with the ecosystem requirements. Lalkaka (2003) and Scaramuzzi (2002) conducted an investigation of the capabilities within TBIs in emerging markets such as China, Brazil, Egypt, India, and some African nations and stated that TBIs are an essential part of the ecosystem in these frugal environments because they provide young firms with capabilities to overcome the prevalent constraints such as high cost of capital, rising inflation, low affordability, lack of business and trade information, high unemployment, declining currency rates, poor intellectual property protections, high cost of acquiring capital, complexities in establishing a business, widespread corruption, etc. Complementary TBI capabilities include: 1) knowledge capabilities for product and service development and commercialization, 2) affordable infrastructure (both physical and digital) for supporting the goals of the startups, 3) synergy and shared knowledge among startups hosted in a TBI as well as other regional TBIs, 4) access to capital, credit, equity, as well as a network of venture capitalist and other professional networks, and 5) support for economic development within the region by generating employment (Lalkaka 2003). Some studies have also shown that the capabilities of the TBIs can play a role in the success of the tenant firms, especially in the case of small firms (Chan and Ahuja 2015). We therefore posit:

*P3: In frugal ecosystems, participating in TBIs leads to higher levels of FITIC.*

We expect that, in frugal ecosystems, superior complementary TBI capabilities lead to superior FITIC.

## **FITIC and Firm Performance**

First, we rely on CRBT and theory of corporate frugality (Anderson and Lillis 2011) to link FITIC to firm performance. Corporate frugality theory is borrowed from contemporary accounting and provides insights into the measurement of corporate frugality which depends on resourceful reuse, spending discipline, and deferred gratification (Anderson and Lillis 2011). Spending discipline refers to the disciplined use of the limited resources of the firm. Resourceful reuse refers to the strategic reduction of wastage and focus on reconfiguring and reusing existing resources rather than buying new ones. Deferred gratification refers to spending in the short run to save in the long run and to managing costs for long term benefits instead of short term cost-cutting. These principles can guide the measurement of FITIC outcomes.

Within frugal ecosystems, it is important to measure firm performance to accurately reflect the contextual challenges. Recently, there has been a shift in how firms are opting to measure their performance. Firms are moving away from using only financial and economic metrics as sole measurements of their performance. They now also include social and environmental metrics in addition to traditional financial performance metrics. This comprehensive measurement of firm performance, called "Triple Bottom Line or TBL or 3BL" is popular in the CSR, marketing, and sustainability literature (Elkington 1997; Norman and MacDonald 2004). The triple bottom line (3BL) is, narrowly defined, an approach to measuring the success of an organization's activities that considers the organization's social and environmental performance in addition to the traditional financial performance (Norman and MacDonald, 2004).

The process of translating FITIC into positive firm performance is complex and difficult to execute. Furthermore, Coman and Ronen (2007) show that to improve performance, constraints can be exploited for both efficiency (reducing operational costs) and effectiveness (adding value). This directly relates to the assertion that resource constraints drive FITIC. Extrapolating further, the process of exploitation of constraints can also be a means of improving performance. Several studies that have used CRBT as a theoretical framework, have referred to the role of IT/IS capabilities in mediating and moderating the relationship between the firm's environment and its success (Chae et al. 2013; Sedera et al. 2016).

Another stream of literature within CSR finds that that in firms with low innovativeness capability, CSR actually reduces customer satisfaction levels and, through the lowered satisfaction, harms market value (Luo and Bhattacharya 2006). This alludes to the importance of FITIC, which allows the firm to simultaneously focus on innovation related to financial performance and social impacts. While the social innovation capability dimension of FITIC is focused on affordability, sustainability, environmental responsibility, responsibility towards the community, etc., there are clear overlaps with many aspects of CSR. More recent findings in the extant marketing literature provide micro-level empirical affirmation

that engaging in social, environmental, and sustainability initiatives offers a competitive advantage when it addresses a key concern of the brand's consumers and necessitates their active participation (Du, Bhattacharya, and Sen 2011). Today, brands engage with their consumers via digital channels such as social media and mobile apps. These technologies are at the foundation of FITIC. Leveraging FITIC appropriately is key to communicating and co-creating value in partnerships with consumers. Moreover, these technologies when coupled with the right business model can replace a firm's dependence on resource-intensive customer relationship management systems, resulting in cost effectiveness and higher profits. With empirical evidence rooted in the CSR and marketing literature, FITIC can be linked with both competitive advantage and higher firm performance. We therefore posit P4 below. Based on the above discussion, our full research model is displayed in Figure 8.

*P4: In frugal ecosystems, high levels of FITIC lead to higher firm performance.*

As an example of how FITIC works in a real-world frugal ecosystem, consider the case of the IGG platform. IGG operates as an orchestrator of a waste collection and recycling ecosystem in a large city in south India (approximate population of 11 million). The city is faced with a complex waste management problem and the municipal as well as civic authorities lack the infrastructure and capabilities to manage collection and disposal of waste. The city was faced with arbitrary disposal of garbage, lack of a systematic process for collection and recycling, and an overall apathetic attitude of the citizens towards garbage disposal resulting in discarding in close proximity to densely populated areas. Moreover, this situation had given rise to an army of ragpickers or wastepickers who were part of the informal or cash-based economy, who were often exploited with inadequate payments and suffered from poor living conditions, irregular incomes, and often fell victim to drug and alcohol addiction.

To alleviate this issue and find a collaborative solution, the local authorities reached out to NGOs, a citizen run policy think tank, and IT companies in the city. This collaboration resulted in the formulation of the IGG digital platform. Its primary goal is to improve the livelihood and working conditions of ragpickers and to help them integrate into mainstream economy. An equally important goal is to involve citizens and communities in solving the problem of managing solid waste in order to keep the city clean. It did this by developing a not-for-profit ecosystem consisting of the IGG platform that was designed, developed, and maintained by an IT firm (whose CSR initiative funded the initial development); an NGO that trained and educated ragpickers in professionalism, communication, collection, and recycling of waste; the local government which established the physical infrastructure of "dry waste collection centres" across the city; and a number of citizen volunteers that were willing to participating as well as spreading awareness about this program. The ecosystem's overall mission was "dignified livelihood for ragpickers, less landfills for all". The cloud-based platform consists of multiple modules and offers a suite of integrated business services, accessed by mobile apps built for waste-pickers, citizens, governments, volunteers, and social businesses. While the physical infrastructure (DWCC) is provided by the government and municipal corporation, IGG provides micro-business services and technology that enable business transactions, communications, reporting, ERP-type backend solutions, and geo-tagging/location services in multiple languages. The base technology layer is built on web services and the cloud while the modules are flexible, adaptable, and customizable for Android-based smartphones and tablets.

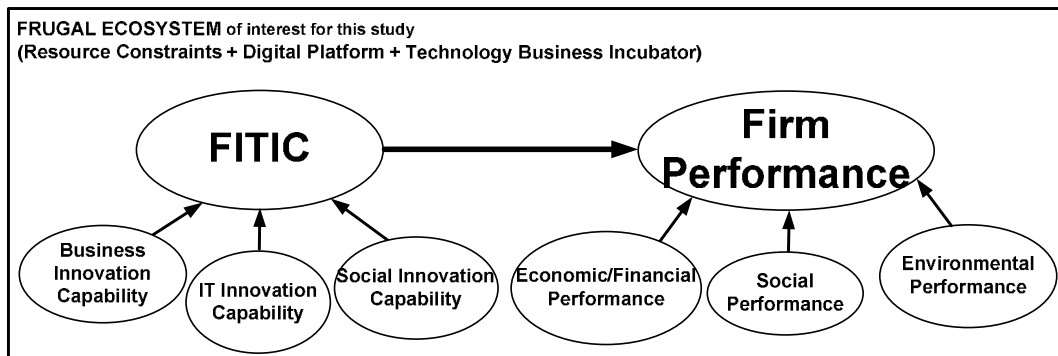
The results of this program, facilitated entirely by the digital platform, have been phenomenal as organized collection and recycling of waste has increased significantly, wastepickers are leading better lives with stable incomes and dignified jobs, and citizens are wholeheartedly volunteering for the program as well as spreading awareness across the city.

## **Contributions**

Research on innovation can no longer be based on strictly defined boundaries of the firm or by following a rudimentary process versus product approach. With the infusion of IT and digital artifacts into all aspects of business and innovation, a more comprehensive outlook on innovation research is required. This paper aims to enrich the literature on IT-enabled innovation and demonstrate how digital capabilities are deeply embedded within ecosystems of firms that want to be at the forefront of business, technology, and social innovation, thus creating an impact on their triple bottom line of profitability, sustainability, and environmental responsibility (Bhattacharya and Sen 2004). Using multiple theoretical lenses, this paper



investigates frugal IT innovation capability within a frugal ecosystem, its dimensions, antecedents, and outcomes. The research recognizes new sources of business value creation in terms of the use of digital business strategies for the facilitation of newer business models in order to serve new markets by leveraging social innovation, IT capabilities, and contextual constraints (Bharadwaj et al. 2013).



**Figure 8: The Research Model**

The paper makes several theoretical contributions. It serves as a response to the call to study emerging trends in digital business strategy (Bharadwaj et al. 2013; El Sawy and Pereira 2013). First, it recognizes that the scope of digital business strategy has evolved and IT and business strategies are increasingly fused together (Bharadwaj et al., 2013). To generate new theoretical insights and newer theory in IT/IS, an in-depth investigation of IT/IS phenomena in contextual settings is recommended (Bharadwaj et al. 2013). This paper therefore attempts to highlight the use of IT in a contextualized setting (of frugal ecosystems) such that the use of FITIC is tightly coupled with business innovation and social innovation (Ahuja and Chan 2014a, 2014b). Second, the paper recognizes the fact that the scale of digital business strategy is rapid and dynamic. It emphasizes the embedded nature of IT not only across the business value chain but also within the broader context of business ecosystems (El Sawy et al. 2010; El Sawy and Pereira 2013). The use of digital platforms for frugal IT innovation is an example of such an embedded IT strategy (Ahuja and Chan 2016). Third, the research acknowledges that the speed of digital business strategy is rapid and firms must develop capabilities to respond to fast-changing market conditions. Therefore, it emphasizes the use of asset-light and flexible IT systems and services in low-cost settings along with developing higher-order LEIT capabilities to take advantage of the underlying systems and technologies.

The paper also offers useful insights for researchers and practitioners. First, it addresses calls for research into ways of improving innovation outcomes by reducing dependence on high-cost resources and instead focusing on resources that are inexpensive and easily available (Fréry, Lecocq and Warnier 2015; Kotler 2011). We also address calls for research into how firms can overcome resource constraints by focusing on frugality and low-cost, creative problem solving (Entrepreneur Media Inc., 2015). Second, firms from developed economies currently face a rising challenge from growth-oriented firms in emerging economies. These emerging market firms enjoy inherent low-cost advantages and maturity in frugal practices (Govindarajan and Ramamurti 2011; Yu 2008). In order to compete globally, it is important for firms in developed markets to learn about how to develop low cost strategies. With issues of affordability and sustainability gaining global attention, frugal IT innovation presents an opportunity for firms to design solutions with strong business, technological and social impacts, thus developing a more holistic innovation agenda. This paper can inform practitioners, as well as government agencies in developed nations, regarding the opportunities and challenges of frugal IT innovation for economic development. This can affect management decision-making as well as government planning of IT infrastructure improvements and investments to improve sustainability, affordability, and competitiveness.

## References

- Acs, Z. J., & Audretsch, D. B. 1990. "The Determinants of Small-firm Growth in US Manufacturing," *Applied Economics*, (22:2), pp. 143-153.
- Agnihotri, A. 2015. "Low-cost Innovation in Emerging Markets," *Journal of Strategic Marketing*, ( 23:5), pp. 399-411.

- Ahuja, S. and Chan, Y.E. 2014a. "Beyond Traditional IT-enabled Innovation: Exploring Frugal IT Capabilities," In the Proceedings of the 20th Americas Conference on Information Systems (AMCIS) Savannah, Georgia, August 2014.
- Ahuja, S. and Chan, Y.E. 2014b. "The Enabling Role of IT in Frugal Innovation," *Proceedings of the International Conference on Information Systems 2014 (ICIS 2014)*, Auckland, New Zealand, December 2014.
- Ahuja, S. and Chan, Y.E. 2016. "Digital Platforms For Innovation In Frugal Ecosystems," Proceedings of the 76th Annual Meeting of the Academy of Management (OCIS Division), Anaheim, USA, August 2016
- Alavi, M., and Leidner, D. E. 2001. "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly*, (25:1), pp. 107-136.
- Amezcuca, A. S. 2010. *Boon or Boondoggle? Business Incubation as Entrepreneurship Policy*.
- Anderson, S. W., and Lillis, A. M. 2011. "Corporate Frugality: Theory, Measurement and Practice," *Contemporary Accounting Research*, (28:4), pp. 1349-1387.
- Aragon-Correa, J.A. and Sharma, S. 2003. "A Contingent Resource-based View of Proactive Corporate Environmental Strategy," *Academy of Management Review*, (28:1), pp. 71- 88
- Ayawongs, N., Kanjana-Opas, A., & Chayabutra, S. 2011. "Development and Future Challenges of Business Incubators in Thailand." Technology Management Center.
- Barney, J. 1991. "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, (17:1), pp. 99-120.
- Bergek, A., & Norrman, C. 2008. "Incubator Best Practice: A Framework," *Technovation*, (28:1), pp. 20-28.
- Bharadwaj, A.S. 2000 "A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation," *MIS Quarterly* 24(1): 169-196.
- Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. 2013. "Digital Business Strategy: Toward a next generation of insights," *MIS Quarterly*, (37:2), pp. 471-482.
- Bhattacharya, C. B. & Sen, S. 2004. "Doing Better at Doing Good: When, why, and how consumers respond to corporate social initiatives," *California Management Review*, (47:1), pp. 9-24.
- Bhatti, Y. 2012. "What is Frugal, What is Innovation? Towards a Theory of Frugal Innovation." (Working Paper SSRN Number: 2005910).
- Bhatti, Y. and Ventresca, M. 2012. "The Emerging Market for Frugal Innovation: Fad, Fashion, or Fit?" (Working Paper SSRN Number: 2005983).
- Birkinshaw, J., Foss, N. J., & Lindenberg, S. 2014. "Combining Purpose with Profits," *MIT Sloan Management Review*, (55:3), pp. 49.
- Bogers, M., & West, J. 2012. "Managing Distributed Innovation: Strategic Utilization of Open and User Innovation," *Creativity and Innovation Management*, (21:1), pp. 61-75.
- Borghoff, U. M., and Pareschi, R. (Eds.). 1998. *Information Technology for Knowledge Management*. Springer.
- Boudreau, K. 2007. "Does Opening a Platform Stimulate Innovation? The effect on systemic and modular innovations." Retrieved from [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=913402](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=913402)
- Bourgeois, L. J. 1981. "On the Measurement of Organizational Slack," *Academy of Management Review*, (6:1), pp. 29-39.
- Boyd, L., Gupta, M., & Sussman, L. 2001. "A New Approach to Strategy Formulation: Opening the Black Box," *Journal of Education for Business*, (76:6), pp. 338-344.
- Brush, T. H., & Artz, K. W. 1999. "Toward a Contingent Resource-based Theory: The Impact of Information Asymmetry on the Value of Capabilities in Veterinary Medicine," *Strategic Management Journal*, (20:3), pp. 223-250.
- Caulier-Grice, J., Davies, A., Patrick, R., & Norman, W. 2012. "Defining Social Innovation," *A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission-7th Framework Programme, Brussels: European Commission, DG Research*.
- Chae, B. K., Yang, C., Olson, D., & Sheu, C. 2014. "The impact of advanced analytics and data accuracy on operational performance: A contingent resource based theory (RBT) perspective," *Decision Support Systems*, 59, 119-126.
- Chan, Y.E. and Ahuja, S. 2015. "Digital Ecodynamics in Small Firms: Using Information Technology to Compete," *Proceedings of the 2015 International Conference on Information Systems*, Fort Worth, TX.

- Chandler, G. N., & Hanks, S. H. 1994. "Market Attractiveness, Resource-based Capabilities, Venture Strategies, and Venture Performance," *Journal of Business Venturing*, (9:4), pp. 331-349.
- Chesbrough, H. 2010. "Business Model Innovation: Opportunities and Barriers". *Long Range Planning*, (43:2), 354-363.
- Chin, V., Dayal, R., Meyer, M., Nettesheim, C., Waltermann, B., and Jing Ting, Y. 2015. "Overcoming Asia's Obstacles to Growth: How Leading Companies Are Reshaping Their Environment," *BCG Perspectives*. Available at: <https://www.bcgperspectives.com/content/articles/globalization-growth-overcoming-asia-obstacles-growth/>
- Christensen, C. 2003. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail," *Harvard Business Review Press*.
- Christensen, C. 2013. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail (10<sup>th</sup> Ed.)," *Harvard Business Review Press*.
- Clark Jr, W. H., & Babson, E. K. 2011. "How Benefit Corporations are Redefining the Purpose of Business Corporations," *Wm. Mitchell L. Rev.*, 38, 817.
- Clarkson, M. E. 1995. "A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance," *Academy of Management Review*, (20:1), pp. 92-117.
- Cohen, W. M., and Levinthal, D. A. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly*, (35:1).
- Coman, A., & Ronen, B. 2007. "Managing Strategic and Tactical Constraints in the Hi-tech Industry," *International Journal of Production Research*, (45:4), pp. 779-788.
- Costello, G., Donnellan, B. and Curley, M. 2013. "A Theoretical Framework to Develop A Research Agenda for Information Systems Innovation," *Communications of the AIS*, (33:1), pp. 26.
- Cusumano, M.A. 2011. "Platform Wars Come To Social Media," *Communications of the ACM*, (54:4), pp.31-33.
- Cyert, R. M., & March, J. G. 1963. A Behavioral Theory of the Firm. *Englewood Cliffs, NJ*, 2.
- Du, S., Bhattacharya, C. B., & Sen, S. 2011. "Corporate Social Responsibility and Competitive Advantage: Overcoming the trust barrier," *Management Science*, (57:9), pp.1528-1545.
- Eisenmann, T.R. 2007. "Managing Proprietary and Shared Platforms: A life-cycle view," Division of Research, *Harvard Business School*.
- Eisenmann, T., Parker, G. and M. Van Alstyne. 2006. "Strategies for Two-sided Markets," *Harvard Business Review*, Oct., pp. 92-101.
- El Sawy, O. A., Malhotra, A., Park, Y., & Pavlou, P. A. 2010. "Research Commentary—Seeking the Configurations of Digital Ecodynamics: It Takes Three to Tango," *Information Systems Research*, (21:4), 835-848.
- El Sawy, O. A., & Pereira, F. 2013. *Business Modelling in the Dynamic Digital Space: An Ecosystem Approach*. Springer.
- Elkington, J. 1997. *Cannibals With Forks. The Triple Bottom Line of 21st Century*.
- Fjeldstad, O. H., Kolstad, I., and Nygaard, K. 2006. *Bribes, Taxes and Regulations: Business Constraints for Micro Enterprises in Tanzania*. Chr. Michelsen Institute.
- Fong, M. 2009. "Technology Leapfrogging for Developing Countries," *Encyclopedia of Information Science and Technology*. Hershey, Pennsylvania: IGI Global, 3707-3713.
- Fréry, F., Lecocq, X., Warnier, V. and Strategy, B.M. 2015. "Competing With Ordinary Resources," *MIT Sloan Management Review*, 26(3), pp.69-77.
- Gallupe, B. 2001. "Knowledge Management Systems: Surveying the Landscape," *International Journal of Management Reviews*, (3:1), pp. 61-77.
- Gawer, A. and Cusumano, M.A. 2014. "Industry Platforms And Ecosystem Innovation," *Journal of Product Innovation Management*, (31:3), pp. 417-433.
- George, G. 2005. "Slack Resources and the Performance of Privately held Firms," *Academy of Management Journal*, (48:4), pp. 661-676.
- Gibbert, M., Hoegl, M., and Valikangas, L. 2007. "In Praise of Resource Constraints: Limitless Material Resources Are Not Only Unavailable Most of the Time, They May Actually be a Hindrance. And Remaining Lean and Mean Can Often Be A Blessing," *MIT Sloan Management Review*, (48:3), pp. 15.
- Giessmann, A. and Stanoevska-Slabeva, K. 2012. "Business Models of Platform as a Service (PaaS) Providers: current state and future directions," *JITTA: Journal of Information Technology Theory and Application*, 13(4), p.31.
- Goldratt, E. M. 1990. *Theory of Constraints*. Croton-on-Hudson: North River.

- Gonzalez, P., Ahuja, S., and Negi, B. 2015. "Multi-Level Innovation Through Co-Creation of Value in Digital Ecosystems: A Conceptual Framework," *Annual Conference of Administrative Sciences Association of Canada (ASAC)*, Halifax, Canada, June 2015
- Govindarajan, V., and Ramamurti, R. 2011. "Reverse Innovation, Emerging Markets, and Global Strategy," *Global Strategy Journal*, (1:3-4), 191-205.
- Grimaldi, R., & Grandi, A. 2005. "Business Incubators and New Venture Creation: An assessment of incubating models," *Technovation*, (25:2), pp. 111-121.
- Haans, R. F., Pieters, C., & He, Z. L. 2015. "Thinking about U: theorizing and testing U-and inverted U-shaped relationships in strategy research," *Strategic Management Journal*.
- Halman, J. I., Hofer, A. P., & Van Vuuren, W. 2003. "Platform-driven Development of Product Families: linking theory with practice," *Journal of Product Innovation Management*, (20:2), pp. 149-162.
- Hamdani, D. 2006. *Conceptualizing and Measuring Business Incubation*. Statistics Canada, Science, Innovation and Electronic Information Division. <http://www.publications.gc.ca/site/archives-archived.html?url=http://www.publications.gc.ca/Collection/Statcan/88F0006X/88F0006XIE2006006.pdf>
- Heeks, R. 2012. "IT Innovation for the Bottom of the Pyramid," *Communications of the ACM*, (55:12), pp.24-27.
- Hewitt-Dundas, N. 2006. "Resource and Capability Constraints to Innovation in Small and Large Plants," *Small Business Economics*, (26:3), pp. 257-277.
- Holsapple, C. (Ed.). 2004. *Handbook on Knowledge Management 1: Knowledge Matters*. Springer Publication, 1(1). Springer.
- Hwang, J., and Christensen, C. M. 2008. "Disruptive Innovation in Healthcare Delivery: A Framework for Business-Model Innovation," *Health Affairs*, (27:5), pp. 1329-1335.
- Iansiti, M. and Levien, R. 2004. "Strategy As Ecology," *Harvard Business Review*, 82(3), pp.68-81.
- Ifandoudas, P., & Chapman, R. 2009. "A Practical Approach to Achieving Agility—a theory of constraints perspective," *Production Planning and Control*, (20:8), pp. 691-702.
- Joseph, R. L., Bordt, M., & Hamdani, D. 2006. *Characteristics of Business Incubation in Canada, 2005*. Statistics Canada, Science, Innovation and Electronic Information Division. <http://www.publications.gc.ca/site/archives-archived.html?url=http://www.publications.gc.ca/Collection/Statcan/88F0006X/88F0006XIE2006007.pdf>
- Kanter, R. M. 1999. "From Spare Change To Real Change: The Social Sector As Beta Site For Business Innovation," *Harvard Business Review*, (77), 122-133.
- Khanna, T. 2014. "Contextual Intelligence," *Harvard Business Review* (92:9), pp. 58-68.
- Khanna, T., Palepu, K.G. and Sinha, J. 2005. "Strategies that Fit Emerging Markets," *Harvard Business Review* (83:6), pp. 4-19.
- Kotler, P. 2011. "Reinventing Marketing to Manage the Environmental Imperative," *Journal of Marketing*, (75:4), pp. 132-135.
- Lalkaka, R. 2003. "Business Incubators in Developing Countries: Characteristics and Performance," *International Journal of Entrepreneurship and Innovation Management*, (3:1-2), pp. 31-55.
- Leibenstein, H. 1969. "Organizational or Frictional Equilibria, X-efficiency, and the rate of Innovation," *The Quarterly Journal of Economics*, 600-623.
- Li, H., and Atuahene-Gima, K. 2001. "Product Innovation Strategy and The Performance of New Technology Ventures in China," *Academy of Management Journal*, (44:6), pp. 1123-1134.
- Liebman, J. B. 2011. "Social Impact Bonds: A promising new financing model to accelerate social innovation and improve government performance," *Center for American Progress*, 9.
- Liu, H., Ke, W., Wei, K. K., and Hua, Z. 2013. "The Impact of IT Capabilities on Firm Performance: The Mediating Roles of Absorptive Capacity and Supply Chain Agility," *Decision Support Systems*, (54:3), pp. 1452-1462.
- Luo, X., & Bhattacharya, C. B. 2006. "Corporate Social Responsibility, Customer Satisfaction, and Market Value," *Journal of Marketing*, (70:4), 1-18.
- Majumdar, S. K., & Venkataraman, S. 1993. "New Technology Adoption in US Telecommunications: The role of competitive pressures and firm-level inducements," *Research Policy*, (22:5), 521-536.
- Mintzberg, H. 2015. *Rebalancing Society*. Berrett-Koehler Publishers.
- Moore, J.F. 1993. "Predators and Prey: A New Ecology of Competition," *Harvard Business Review*, (71:3), pp.75-83.

- Mugavero, R., Benolli, F. and Sabato, V. 2015. "Geospatial Intelligence, Technological Development, and Human Interaction," *Journal of Information Privacy and Security*, (11:4), pp.243-261.
- Mundim, A., Sharma, M., Arora, P., and McManus, R., 2012. Emerging-Markets Product Development and Innovation: The New Competitive Reality. *Accenture Report 2012*. <http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Emerging-markets-Product-Development-and-Innovation.pdf>
- Nevo, D., and Chan, Y. E. 2007. "A Delphi Study of Knowledge Management Systems: Scope and Requirements," *Information and Management*, (44:6), pp. 583-597.
- Nicholls, A., Simon, J., & Gabriel, M. (Eds.). 2015. *New Frontiers in Social Innovation Research*. Palgrave Macmillan.
- Nohria, N., and Gulati, R. 1996. "Is Slack Good or Bad for Innovation?," *Academy of Management Journal*, (39:5), pp. 1245-1264.
- Norman, W., & MacDonald, C. 2004. "Getting to the Bottom of Triple Bottom Line," *Business Ethics Quarterly*, (14:02), pp. 243-262.
- Orlikowski, W.J., Barrett, M. 2014. "Digital Innovation in Emerging Markets: A Case Study of Mobile Money," *MIT Center for Information Systems Research Briefing*, 14(6). Retrieved May 11, 2015, from <http://cisr.mit.edu/>.
- Orlitzky, M., Schmidt, F. L., & Rynes, S. L. 2003. "Corporate Social and Financial Performance: A meta-analysis," *Organization Studies*, (24:3), pp. 403-441.
- Orlitzky, M., Louche, C., Gond, J. P., & Chapple, W. 2015. "Unpacking the Drivers of Corporate Social Performance: a multilevel, multistakeholder, and multimethod analysis," *Journal of Business Ethics*, 1-20.
- Osterwalder, A., Pigneur, Y., & Tucci, C. L. 2005. "Clarifying Business Models: Origins, Present, and Future of the Concept," *Communications of the Association for Information Systems*, (16:1), pp. 1.
- Overby, E., Bharadwaj, A., and Sambamurthy, V. 2006. "Enterprise Agility and the Enabling Role of Information Technology," *European Journal of Information Systems*, (15:2), 120-131.
- Parker, S. C., Congregado, E., Golpe, A., & Saxenian, A. 2015. "20 Incubators and Accelerators. Concise Guide to Entrepreneurship," *Technology and Innovation*, 3, pp. 108
- Parker, G. and M. Van Alstyne. 2005. "Two-Sided Network Effects: A Theory of Information Product Design," *Management Science*, (51:10).
- Paulson Gjerde, K. A., Slotnick, S. A., & Sobel, M. J. 2002. "New Product Innovation with Multiple Features and Technology Constraints," *Management Science*, (48:10), pp. 1268-1284.
- Pavlou, P. A. and El Sawy, O. A. 2010. "The 'Third Hand': IT-enabled Competitive Advantage in Turbulence Through Improvisational Capabilities," *Information Systems Research*, (21:3), 443-471.
- Porter, M. 2015. "Why Social Progress Matters," *Project Syndicate*. <http://www.project-syndicate.org/commentary/economic-development-social-progress-index-by-michael-porter-2015-04>
- Porter, M. E., & Kramer, M. R. 2002. "The Competitive Advantage of Corporate Philanthropy," *Harvard Business Review*, (80:12), pp. 56-68.
- Porter, M. E. & Kramer, M. R. 2007. "The Link Between Competitive Advantage and Corporate Social Responsibility," *Harvard Business Review*.
- Prahalad, C.K. and Mashelkar, R.A. 2010. "Innovation's Holy Grail," *Harvard Business Review*: July–August.
- Radjou, N., and Prabhu, J. 2015. *Frugal Innovation: How to do more with less*. Profile Books
- Rao, H., and Drazin, R. 2002. "Overcoming Resource Constraints on Product Innovation by Recruiting Talent from Rivals: A Study of the Mutual Fund Industry, 1986–1994," *Academy of Management Journal*, (45:3), pp. 491-507.
- Rhee, S. H., Cho, N. W., & Bae, H. 2010. "Increasing the Efficiency of Business Processes using a Theory of Constraints," *Information Systems Frontiers*, (12:4), pp. 443-455.
- Richardson, S., Kettinger, W.J., Banks, M.S. and Quintana, Y. 2014. "IT and Agility in the Social Enterprise: A Case Study of St Jude Children's Research Hospital's "Cure4Kids" IT-Platform for International Outreach," *Journal of the Association for Information Systems*, (15:1), pp. 2.
- Rivard, S. 2004. *Information Technology and Organizational Transformation: Solving the Management Puzzle*. Routledge.
- Rosca, E., Arnold, M., & Bendul, J. C. 2016. "Business Models for Sustainable Innovation—an empirical analysis of frugal products and services," *Journal of Cleaner Production*.

- Ross, J. 2014. "Do You Have a Great Digital Business Strategy?" *MIT Center for Information Systems Research*. <http://cisr.mit.edu/blog/blogs/2014/09/24/digital-business-strategy/>
- Sabherwal, R., and Sabherwal, S. 2005. "Knowledge Management Using Information Technology: Determinants of Short Term Impact on Firm Value," *Decision Sciences*, (36:4), pp. 531-567.
- Sahay, S., and Walsham, G. 2006. "Scaling of Health Information Systems in India: Challenges and Approaches," *Information Technology for Development*, (12:3), 185-200.
- Scaramuzzi, E. 2002. "Incubators in Developing Countries: Status and development perspectives," Washington DC: The World Bank.
- Scholten, S., and Scholten, U. 2012. "Platform-based Innovation Management: directing external innovational efforts in platform ecosystems," *Journal of the Knowledge Economy*, (3:2), pp. 164-184.
- Sedera, D., Lokuge, S., Grover, V., Sarker, S., & Sarker, S. 2016. "Innovating with Enterprise Systems and Digital Platforms: A Contingent Resource-Based Theory View," *Information & Management*.
- Sharma, A., & Iyer, G. R. 2012. "Resource-constrained Product Development: Implications for green marketing and green supply chains," *Industrial Marketing Management*, (41:4), pp. 599-608.
- Somsuk, N., Wonglimpiyarat, J., & Laosirihongthong, T. 2012. "Technology Business Incubators and Industrial Development: Resource-based View," *Industrial Management & Data Systems*, (112:2), pp. 245-267.
- Spector, Y. 2011. "Theory of Constraint Methodology Where the Constraint is the Business Model," *International Journal of Production Research*, (49:11), pp. 3387-3394.
- Tallon, P. P. 2008. "Inside the Adaptive Enterprise: An Information Technology Capabilities Perspective on Business Process Agility," *Information Technology and Management*, (9:1), pp. 21-36.
- Tan, B., Pan, S.L., Lu, X. and Huang, L. 2015. "The Role of IS Capabilities in the Development of Multi-Sided Platforms: The Digital Ecosystem Strategy of Alibaba.com," *Journal of the Association for Information Systems*, (16:4), pp. 248-280.
- Tanriverdi, H. 2005. "Information Technology Relatedness, Knowledge Management Capability, and Performance of Multibusiness Firms," *MIS Quarterly*, pp. 311-334.
- Tanriverdi, H., Rai, A., and Venkatraman, N. 2010. "Research commentary-Reframing the Dominant Quests of Information Systems Strategy Research for Complex Adaptive Business Systems," *Information Systems Research*, (21:4), 822-834.
- The Center for Social Innovation at Stanford University. 2014. Available at: <http://csi.gsb.stanford.edu/social-innovation>
- Trajtenberg, M. 1990. "A Penny for Your Quotes: Patent Citations and the Value of Innovations," *The Rand Journal of Economics*, 172-187.
- Valor, C. 2005. "Corporate Social Responsibility and Corporate Citizenship: Towards Corporate Accountability," *Business and Society Review*, (110:2), pp. 191-212.
- Varadarajan, R. 2011. "Conjectures on Innovation Drivers in an Emerging Market: India," in D. G. Subhash Jain (Ed.), *Handbook of Research in International Marketing*, pp. 117-134. Edward Elgar.
- Wade, M. and Hulland, J. 2004. "Review: The Resource-based View and Information Systems Research: Review, Extension, and Suggestions for Future Research," *MIS Quarterly*, (28:1), pp. 107-142.
- Watson, R. T., Kunene, K. N., & Islam, M. S. 2013. "Frugal Information Systems (IS)," *Information Technology for Development*, (19:2), 176-187.
- Weill, P. and Woerner, S.L. 2013. "The New Digital Divide: Emerging Trump Developed Economies," MIT Center for Information Systems Research, Research Briefing, (13:10). Retrieved April 25, 2014 from [http://cisr.mit.edu/blog/documents/2013/10/17/2013\\_1001\\_newdigitaldivide\\_weillwoerner.pdf/](http://cisr.mit.edu/blog/documents/2013/10/17/2013_1001_newdigitaldivide_weillwoerner.pdf/)
- Wierenga, M. 2015. "Local Frugal Innovations: How do resource-scarce innovations emerge in India?," Thesis available at: <https://aaltodoc.aalto.fi/handle/123456789/18429>
- Yu, L. 2008. "Competing Against Low-cost Countries," *MIT Sloan Management Review*, (49:2), pp. 9.
- Zahra, S. A., and George, G. 2002. "Absorptive Capacity: A Review, Reconceptualization, and Extension," *Academy of Management Review*, (27:2), pp. 185-203.
- Zaltman, G., Duncan, R., & Holbeck, J. 1973. *Innovativeness and Organizations*. NY: John Wiley & Sons.