ABSTRACT

Title of Document: IT ENABLED SERVICE INNOVATION:
                                   STRATEGIES FOR FIRM PERFORMANCE

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       This dissertation seeks to understand firm strategies and implications for

sustainability and success in the context of IT-enabled service innovations. The first

essay examines how business models evolve to influence the financial sustainability

and maturity of health information exchanges (HIE), a new organizational form in the

United States healthcare landscape to facilitate electronic health information sharing

across multiple stakeholders such as hospitals, doctors, laboratories, and patients.

The study focusses on two components of business models of HIEs: the customer

value proposition that is manifested through three categories of service offerings (e.g.,

foundational, vendor driven and advanced), and two revenue model approaches to

earn profits (e.g., subscription and transaction-based revenues models). Using an

unique archival data set constructed from surveys of HIEs in the US from 2008 to

2010 for empirical analysis; we find that foundational IT enabled service offerings have higher positive influence on operational maturity and financial sustainability, compared to vendor driven or advanced service offerings. Further, findings show subscription-based revenue models are more advantageous for sustainability in early stages, while transaction-based revenue models lead to higher operational maturity in later stages.

The second essay investigates how two dimensions of IT enabled service augmentation, i.e., value added service and customer care, interplay with core services to influence customer satisfaction with cell phone services in base-of-the-pyramid (BOP) markets. Arguing for price- and relational- evaluations, we develop hypotheses for a substitution effect of value added services, and a complementary effect of customer care, on the relationship between core service and customer satisfaction. Specific to the BOP market context, we further proposed a differentiated influence of service augmentation for different categories of providers based on their institutional contexts and investment strategies. We empirically examine and find support for the hypothesized relationships using an archival data set from surveys of over 3,400 cell phone customers across 34 providers in seven South Asian countries.

The two studies contribute to existing literature in exploring the factors associated with firm performance, and derive managerial implications to effectively manage and profit from IT enabled service innovations. Overall, the dissertation has research and practice implications to gain an understanding of the appropriate strategies to increase firm performance in the context of IT enabled service innovations.

IT ENABLED SERVICE INNOVATION: STRATEGIES FOR FIRM
PERFORMANCE

By

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Chapter 1: Dissertation Overview

Businesses across the globe are increasingly turning towards innovation in service as a form of competitive differentiation (Gustafsson and Johnson 2003). The capabilities offered by information technologies (IT) play a key role in enabling service innovation, and firms are actively exploring ways in which their service offerings can be enhanced through the application of IT. Successful deployment of IT enabled services requires an understanding of not only the underlying IT, but also of the interactions that need to occur between the technology and various aspects of a firm's operations and strategy. In this context, managers are challenged with the complexity of effectively leveraging IT in services to enhance firm performance. To address this complexity, researchers and practitioners have begun to focus increased attention on understanding the role of IT in the service delivery process and how it can create value.

This dissertation, comprised of two essays, theorizes and empirically examines the influence of two distinct organizational strategies, i.e., digital business model and IT-enabled service augmentation, on the performance of two specific IT enabled service innovations. Next, a brief overview of IT enabled service innovation is provided, followed by an outline of the two essays.

1.1. IT Enabled Service Innovation

In the past two decades, economies across the world have been rapidly transforming their production base from manufacturing and agriculture towards

services. In industrialized nations such as the United States (US) and the United Kingdom (UK), services account for more than 75 % of labor (Karmarkar 2004; Larson 2008; Paulson 2006). In the US, revenues from different segments of the services industry experienced growth in the range of 1-5% in 2009-2010 (see Table 1, for revenues in the US services sector, categorized as per NAICS code). In countries such as Brazil, Russia, Japan and Germany, services account for more than 50% of the labor, whereas across several other developing nations, the share of services accounts for 15% to 20% of the total trade market.

As a consequence of the growing focus on services, firms are creating, designing and offering new services, service processes, and service business models that create value for customers, employees, business owners, alliance partners, and communities that are engaged with the service delivery; i.e., firms are creating what has been labeled as *service innovations* (Ostrom et al. 2010). Increasingly service innovations are becoming a strategic tool for firms as a source of competitive differentiation in almost all sectors (Gustafsson and Johnson 2003).

The shift to a services base has created significant challenges for businesses. To the degree that services are subject to greater change and evolution as compared with products, companies need to develop capabilities to be innovative, flexible and agile enough to react to the service shift of economies. Businesses are responding to this challenge with the help of advancements in information technology to enable service innovations (Rai et al. 2006; Sambamurthy et al. 2003).

Firms are actively exploring ways in which their service offerings can be enhanced through the application of information technology (IT), as the capabilities offered by IT has the potential to play a key role in enabling service innovation. We define *IT enabled service innovations* as the ways in which firms leverage and exploit IT resources to conceive, structure, implement, offer, manage, and augment services and service capabilities. Examples of IT enabled service innovation may be found in a diverse set of companies in virtually every sector of the economy. To illustrate, established, predominantly product-oriented firms, such as BMW and GE are deploying IT to offer stand-alone services or product-service bundles (i.e., they are engaging in the servitization of products). A set of firms, such as Google, Facebook, and Netflix are emerging with unique value chains and service portfolio designs that are principally constructed on an IT based platform. Other firms such as HP, IBM, and Dell are positioning themselves as total solution providers, by combining services, products, and logically related activities across multiple processes in a client's value chain.

The variety of IT enabled service innovations is striking and they can occur at different levels and in different ways, such as: (1) IT enabled innovation in service products; (2) IT enabled innovation in service processes; (3) IT enabled service innovation in service firms, organizations, and industries. This categorization of IT enabled service innovation is consistent with discussions in the existing literature that service innovation can be in the form of new or improved service products, or service innovation can be related to new or improvised processes such as innovation in service delivery systems or in supply chains. Further, service innovation can exist in

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service firms, organizations, and industries or through management of service organizations (Bitner et al. 2008; Edvardsson et al. 2010; Hipp and Grupp 2005).

We clarify the concept of IT enabled service innovation further. First, IT enabled service innovations are not limited to service provider firms. Insofar as they are related to a service delivery process, they can occur in the domains of both service provider firms and their service delivery partners. For example, a newly developed high speed networking solution installed by a bank's IT service provider can help the bank to enable faster connectivity for its customers. Second, such innovations are not limited to the primary or supporting activities of a firm's value chain. Rather, such innovations can really bring a new value proposition as an additional layer to the firm's primary and supporting activities. For instance, a service innovation may involve re-organizing or re-designing the communication activities performed by the service provider firm, that may not be central to the service delivery process, e.g., how letters from customers can be processed internally, or how web services can be modified to track the location of customers who order through online web interfaces. However, a service innovation of providing complementary products or value added services may add additional revenue opportunities – that would become an additional layer of value chain activities for the focal firm.

To summarize, the concept of IT enabled service innovation implicates the focal role that IT can play in the creation, redefinition, and establishment of service and service management capabilities. Some of these capabilities are service innovations in terms of providing new or modified service offerings, service processes, and service business models. In other words, IT enabled service

innovations encompass a gamut of activities that leverage and exploit IT for services. Thus, we adopt the perspective that the IT enabled service innovation has a domain that extends beyond the technology. This view is different than existing discussions in the literature where IT enabled service innovations are considered as only technological innovations in services, similar in spirit to innovations in the manufacturing or production areas (Johnson et al. 1999; Paulson 2006).

The impact of IT enabled service innovations is visible in multiple sectors of the economy. First, IT enabled service innovations have fundamentally transformed business processes in some industries, improving their efficiency and effectiveness. For example, in the retail sector, organizational IT capabilities have enabled firms to develop the higher-order capability of supply chain process integration (Rai et al. 2006). Second, IT enabled service innovations are critical components of managing the complexities involved with customer centric solutions. For example, banks are able to provide online banking services to customers by building customized portals and websites on an IT infrastructure.

Third, as a result of inter-firm integration enabled by IT, service providers are able to integrate service provisions across industries and firms to create customer value. To illustrate, providers such as Expedia, Travelocity and Priceline bundle discounted flight, hotel and car bookings together on a real-time basis in one single interaction with the customer through the Internet. The benefits to be realized from IT service innovations are striking, as they span a gamut of activities from providing business intelligence, to operational excellence, to enhanced customer support. While the movement of some industry sectors such as banking towards IT enabled services

has been swift and broad-based, other sectors such as healthcare are beginning to recognize the value potential of IT enabled services through expedited adoption of IT systems (Agarwal et al. 2010).

Although the value potential of IT enabled service innovations is substantial, effective conceptualization and execution of these activities is difficult for both incumbents and new firms. Organizations grapple with the challenge of modifying and integrating their business processes with IT capabilities and IT enabled processes. For example, although electronic health records were developed almost a decade ago, their adoption by healthcare service providers has been limited, in part due to the difficulty of integrating the technology into their existing practices.

A second impediment confronting managers is the need to envision new strategies that include a portfolio of IT enabled service innovations when existing firm structures and strategies are not aligned with IT enabled services. For example, the brick and mortar business process of delivering movie VCDs and DVDs is swiftly being replaced by the service of online streaming of movies – a service provided by Netflix. As a result, the existing business models of Blockbuster and Redbox are under threat.

Third, managers of service providing organizations struggle with the problem of efficiently allocating and managing client oriented IT and non-IT based resources and capabilities for service delivery. Specifically, in outsourcing contexts, the complexity of managing capabilities for IT enabled services has led to failures of IT based service firms. To illustrate, the inability to develop appropriate capabilities to

manage resources has led to abrupt terminations of service contracts for more than 40% of offshore IT service providers (Weakland and Tumpowsky 2006; 2007).

Against this backdrop of the promise and challenges of IT enabled service innovations, this dissertation seeks to understand the conditions under which IT enabled service innovations deliver firm value, and inform the design of business operations and strategy to leverage service innovations.

1.2. Objectives of Essays

The two essays in this dissertation focus on two research questions, with a common unifying theme of exploring how firms are developing strategies for sustainability and success in the context of IT enabled service innovations.

Essay I addresses the research question: *how do components of a business model evolve to influence the sustainability of health information exchanges?* The IT enabled service innovation context for this study is the digital exchange platform provided by the health information exchanges (HIE) in the United States. HIEs facilitate the electronic mobilization and sharing of healthcare information across organizations within a region, community or hospital system. The failure and lack of sustainability of several HIEs within few years of initiation provide the motivation for this study. We explore the influence and evolution of two components of business models: (1) customer value proposition through service offerings to create value for the enterprise, and (2) revenue models that convert payments received to profits. We argue that the business models of HIEs evolve with time in response to the changing environment, and therefore, the composition of the service offerings and revenue

models need to change to influence the sustainability. We develop hypotheses to investigate how the influence of the two focal business model components on sustainability is contingent on the age and mediated by the operational maturity of the HIEs. We empirically examine and find support for the hypothesized relationships using a unique archival data set constructed from surveys in the years 2008, 2009 and 2010; conducted by an agency engaged with tracking of HIEs in the United States. We discuss the implications and contributions of the findings.

Essay II of this dissertation addresses the research question: *how IT enabled service augmentation influences customer satisfaction for cell phone services in the base-of-the-pyramid (BOP) markets.* The BOP markets are targets for most multinational cell phone companies to expand their businesses. To offset the low average revenue per user (ARPU) in these markets, providers are offering several value added services. At the same time, the cell phone companies are focusing on enhancing customer care through deployment of IT-based customer support processes. The value proposition of these two IT enabled services of cell phone providers has not been explored in the existing literature. In this study, we conceptualize value added services and IT-based customer care, as two dimensions of IT-enabled service augmentation. We explore how these two dimensions interact with core service to influence customer satisfaction for cell phone services in the base-of-the-pyramid (BOP) markets. The context of BOP markets adds a layer of complexity to the study, as the customers in these markets are typically low-income and highly conscious of the price-value comparison of value added services. Arguing for price- and relational- evaluations, we develop hypotheses for a substitution effect of value

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added services, and a complementary effect of customer care, on the relationship between core service and customer satisfaction. Specific to the BOP market context, we further propose a differentiated influence of service augmentation for different categories of providers based on their institutional contexts and investment strategies. We empirically examine and find support for the hypothesized relationships using an archival data set from surveys of over 3,400 cell phone customers across 34 providers in seven South Asian countries. We discuss the managerial implications and contributions of the findings.

Overall, the two essays focus on addressing two key issues in the context of two distinct IT-enabled service innovations, i.e., business model evolution for sustainability of health information exchanges (HIEs), and service augmentation for customer satisfaction for cell phone providers. The HIEs in the first study are entrepreneurial firms struggling in the complex US healthcare sector in delivering the digital health information exchange services. In contrast, the cell phone service context of the second study is set in the challenging base-of-the-pyramid markets (BOP) of seven south Asian countries. Strategically leveraging the deluge of value added services to influence customer satisfaction in the chronic churn prone and highly value conscious BOP markets remains a huge challenge for cell phone providers.

Table 2 provides a comparative framework for the two essays, summarizing similarities and distinctions on multiple dimensions.

1.3. Tables for Overview Section

Table 1: Total Revenue from Service Sectors in US in 2009 and 2010

NAICS code	Category of service business sector	Total revenue (millions of dollars)		Growth (%)
		2010	2009	
48-49	Transportation and warehousing	210,299	198,881	5.7
51	Information	863,481	839,862	2.8
52	Finance and insurance	2,406,966	X	X
532	Rental and leasing services	90,606	89,793	0.9
54	Professional, scientific, and technical services	1,018,719	972,284	4.8
56	Administrative, support, waste management and remediation	448,182	426,163	5.2
62	Health care and social assistance	1,371,581	1,333,836	2.8
71	Arts, entertainment, and recreation	132,477	133,628	-0.9
81	Other services	264,745	260,754	1.5

X: data not available

Table 2: Dissertation Framework

	Essay I	Essay II
Motivation	Sustainability of entrepreneurial firms delivering IT enabled services	Strategic service choices of cell phone providers BOP market contexts to reduce churn
Research question	How do business models influence the sustainability of health information exchanges	How IT enabled service augmentation influences customer satisfaction for cell phone services in BOP markets
Business structure	Business-to-business, collaborative networked transaction model	Business-to-customer, direct provider-customer interaction model
IT enabled service innovation	Health information exchange platforms	Value added service and customer support platforms deployed by the cell phone service providers
Service provision	Digital information exchange	Communication, information access and exchange, and entertainment services
Organization phase	Gestation period	Established in markets
Industry	Healthcare	Mobile communication
Market	United States of America	Seven South Asian emerging and developing countries
Dependent variable(s)	Financial breakeven, operational maturity	Overall Customer satisfaction
Key independent variable(s)	Three categories of service offerings as customer value proposition; subscription and transaction revenue models	Satisfaction with value added services, satisfaction with customer care, provider characteristics, operating and capital expense ratio

Chapter 2: How Should Firms Evolve Their Business Models for Sustainability? The Case of Health Information Exchanges

2.1. Abstract

Information technology (IT) is a significant driver of entrepreneurial activity, yet many IT-enabled ventures do not become sustainable businesses. Often, the failure to achieve sustainability is attributed to both the initial design of the venture's business model as well as the inability to evolve the business model over time. This study focuses on and examines the influence of two components of business models and their evolution on the sustainability of health information exchanges (HIEs) in the United States: the customer value proposition (i.e., three categories of service offerings: foundational, vendor driven and advanced), and revenue model (subscription versus transaction-based approaches). HIEs are new organizational forms that facilitate digital exchange of health data across multiple stakeholders, and are central to the envisioned digital transformation of healthcare. We use a unique archival data set constructed from surveys of HIEs in the US from 2008 to 2010 for empirical analysis. We find that the effect of a core service bundle on operational maturity becomes stronger with age of the HIE. Disaggregating core services into the three categories, we find that with the passage of time, foundational service offerings have higher positive influence on operational maturity and financial sustainability, compared to vendor driven or advanced service offerings. Age also influences the effect of revenue models on sustainability: while subscription-based revenue models are more advantageous in early stages, transaction-based revenue models lead to

higher operational maturity in later stages. Finally, findings show that the influence of business model components on financial sustainability is mediated by operational maturity. This study contributes to the existing research in information systems and strategy by investigating the impact of components of a digital business model on sustainability of firms that provide electronic information exchange and mediation services.

2.2. Introduction

Information technology has widely been identified as a significant driver of innovation and entrepreneurship, generating significant economic and social value worldwide (Brynjolfsson and Saunders 2010). But new ventures are not without risk -- high rates of failure among information technology (IT) based ventures have raised questions in practitioner and scholarly communities related to the viability of these businesses. Although early venture funding or grants may help new firms commence operations, a firm becomes *sustainable* only when it achieves financial breakeven, and is able to support and maintain operations through its own stream of revenues and profits (Bamford et al. 2000; Gilbert et al. 2006). According to some estimates, between 30 to 50 percent of new business ventures reach operational status, with even fewer eventually becoming financially sustainable (Parker and Belghitar 2006; Reynolds 2007).

Sustainability of IT-based entrepreneurial initiatives is a major concern in the context of health information exchanges (HIEs), a new organizational form that has recently emerged in the U.S. healthcare sector. HIEs are a direct consequence of U.S. government policies mandating greater digitization of healthcare to enable critical health information to flow seamlessly across the multitude of players involved in healthcare delivery (Adler-Milstein et al. 2009; Walker et al. 2005). Industry reports on these new organizations note that despite an upward trend in operational HIEs from 29% in 2009 to 35% in 2010, less than 30% have become financially sustainable (eHealth Intiative 2009). Other studies reveal that only 41% have been able to cover operating costs with revenue from participating entities, and less than half of the

remaining 59% of HIEs expect to eventually do so (Adler-Milstein et al. 2009). The disappointing progress of HIE organizations to date, coupled with widely discussed failures such as an HIE in Santa Barbara, California and one in northeastern Pennsylvania, point to a pressing need to understand the factors that influence the sustainability of these vital organizations (Miller and Miller 2007).

We approach the puzzle of HIE sustainability through the lens of a business model. At its core, a business model is fundamentally a roadmap that aligns a firm's technical potential with market-based revenue generation opportunities for the realization of economic value (Chesbrough 2007; Teece 2010). Inappropriate design of business models has been offered as a key explanation for the failure of exchange-based businesses in particular (Ganesh et al. 2004; Koch 2002), as poor design often results in service bundles that are not responsive to market needs. More generally, proponents of business models suggest that they can steer an entrepreneurial firm toward sustainability through efficient deployment of resources, and expedited implementation of value creation capabilities (Zott and Amit 2007; 2008). Indeed, the concept of a business model is widely invoked in the business press, with CEOs frequently alluding to their company's business model (e.g., GE business model (Welch 2003), Dell business model (Maney 2003), Boeing's business model (Bair 2008)). Much as business models refer to an articulation of activities to produce value, they also provide a concept to address changes related to a firm's value creation process (Demil and Lecocq 2010); and a sense of a firm in action to address the changes in the environment (McGrath 2010). However, such frequent use in practice notwithstanding, systematic research on business models and the influence of

business model design on sustainability is sparse, with the exception of a few studies (for a review, see Zott et al. 2011).

We pose the question: how do components of a business model evolve to influence the sustainability of health information exchanges? An HIE is deemed to be sustainable when it achieves *financial breakeven* as a result of the revenue earned from the services offered to customers, beyond the grants or venture funds used for initiation (Adler-Milstein et al. 2010). Along with financial breakeven, we use *operational maturity,* which characterizes the functional and operational progress of a new venture through typical growth stages, as a second measure of sustainability.

Although there is limited consensus in the literature on what specific elements comprise a business model, there is considerable overlap in the components identified as relevant to business models. We ground the conceptualization of central business model components in Teece's (2010, p. 173) observation that "..a business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits." In addition to theorizing the customer value proposition and revenue model as drivers of sustainability, acknowledging the digital nature of the HIE business, we isolate and control for two additional elements of a digital business model (Johnson et al. 2008), that may be relevant to study sustainability of HIEs: the *IT architecture* reflecting on the key IT resource of the HIE, and the *IT access mode* that assesses the flexibility offered by the IT processes of the platform to support different access options to customers. Based on discussions in the strategy literature that firm evolution occurs with time in response to the changing environment of firms (Rindova and Kotha 2001; Zollo and Winter

2002), we investigate how the influence of the two focal business model components on sustainability is contingent on the age and mediated by the operational maturity of the HIEs.

The empirical analysis is based on a unique archival data set constructed from surveys conducted by the eHealth Initiative (http://www.ehealthinitiative.org/) in 2008, 2009 and 2010. This study contributes to the information systems and strategy literature by examining the differential influence of core components of digital business models and their evolution on firm sustainability. To the degree that HIEs are struggling to establish themselves in a sector characterized by considerable upheaval and growing competition, they provide a rich empirical setting to investigate how business model components influence the performance of new ventures at an early stage of development (Adler-Milstein et al. 2010; Maffei et al. 2009). Furthemore, HIEs have been idenitfied as critical for achieving healthcare transformation and play an important role in society. As one of the first large-scale empirical studies on HIE sustainability, the study also contributes to the healthcare management literature by identifying key factors that influence the viability of organizations that are essential for improving quality and safety in healthcare delivery.

2.3. Background and Prior Literature

The notion of digital information exchanges is novel for the U.S. healthcare system, although digitized exchanges are common in other industries such as finance, banking, telecommunications and airlines (Goldfarb et al. 2005). In U.S. healthcare, some non-digital forms of exchanges existed previously as community health

information networks that enabled organizations such as doctors' offices, hospitals, and laboratories to share patient information. With accelerated adoption of health information technologies (HIT), such as the electronic medical records (Agarwal et al. 2010), some argue that digital information exchanges can potentially increase the value derived from HITs in increasing productivity and quality of healthcare organizations, and advance the nation in the widely sought change in healthcare practice through improved use of information systems (Abraham and Junglas 2011; Kohli and Kettinger 2004; Menon et al. 2000). However, healthcare entities might have concerns for data sharing and exchange, such as hospitals unwilling to share data because of competitive concerns, or individual physicians reluctant to share data to avoid the complexities involved with data digitization and exchange (Grossman et al. 2008), that plausibly deters their active participation in HIE initiatives.

As noted, HIEs as yet have not been able to adequately satisfy the differing interests of multiple stakeholders in U.S. healthcare, raising concerns about their economic viability. Adler-Milstein et al. (2010) reported that HIE viability is associated not only with the set of data being exchanged, but also with the range of involved stakeholders such as hospitals, pharmacies and physicians. A plausible explanation for the less than stellar progress of HIEs is that much like the business-to-business exchanges that emerged at the turn of the century, they have been unable to construct the correct business model (Ganesh et al. 2004; Gosain and Palmer 2004).

Surprisingly, the notion that sustainability of digital exchange platforms is likely dependent on business model design has received relatively little attention in the existing information systems literature. By contrast, the strategy literature has

increasingly invoked the business model as a key construct for explaining firm survival and performance (Chesbrough 2007; Teece 2010). Prior studies suggest that business models can help to define new organizational structures and customer-centric value propositions to achieve competitive advantage (Amit and Zott 2001; Shafer et al. 2006). In the specific instance of digital businesses, studies suggest that business models can be instrumental in alignment between IT and business (Osterwalder et al. 2005), by enabling exchange efficiency amongst participants (Koch and Schultze 2011), and value appropriation through the digital exchange platforms (Dai and Kauffman 2002).

There is some disagreement in the literature in regard to the significance of business models for new ventures. Some researchers suggest that the growth and success of new organizations is largely due to the crafting of appropriate business models at the planning stage (George and Bock 2011; Hedman and Kalling 2003), while others argue that business models are simply demonstration activities to satisfy investors and promoters (Lange et al. 2007). Researchers point to the inconclusive empirical results of influence of business models on firm success (Gruber 2007; Karlsson and Honig 2009), underscoring the importance of further work on this relationship. A recent review of existing literature on business models by Zott et al. (2011) notes that very few studies have conducted rigorous empirical investigations of components of business models on firm sustainability, and almost none have explored the impact of business model evolution at early venture stages on sustainability. This study seeks to address this gap in extant literature to understand

the relationship between business models and firm viability in the context of an emerging digital business.

2.4. Theory and Hypotheses

The conceptual model underlying this study, shown in Figure 1, builds upon Teece (2010) to suggest that the customer value proposition and revenue model influence the financial sustainability and operational maturity of HIEs. The former outcome assesses the extent to which the firm is able to generate revenue that is greater than cost, operationalized by whether the HIE has achieved financial breakeven as a result of operational revenue; while the latter indicates the progress of the firm through different stages, independent of its financial achievements. Operational maturity is operationalized by a seven-stage maturity framework developed by ehealthinitiative.org, specifically to track HIE progress, and includes the stages of initiation, structure formation, plan formulation, plan implementation, technology operation, commercial operation and collaboration with stakeholders. Although specific to the HIE context, the seven-stage maturity model is based on similar stage models in prior research (Gilbert et al. 2006); e.g., a new ventures growth model of conception, development, commercialization, growth and stability (Kazanjian and Drazin 1989), and a firm progression model of existence, survival, success, take-off and resource maturity (Churchill and Lewis 1983).

The customer value proposition is reflected in the *extensiveness of service offerings* while the *revenue model* captures what the HIE utilizes as the template for its profits. Because the HIE is fundamentally a digital platform for enabling

information exchange, we extend Teece (2010) and draw from the business model-value creation framework suggested by Johnson et al. (2008) to include two additional components: *IT architecture* that reflects the key IT resources of the HIE, and *IT access mode* that indicates the extent to which the IT processes of the platform support different access options to customers. To the extent that the service bundle and revenue model are primary value adding components of the HIE's business model, we restrict our theoretical focus on these two components and investigate how they need to evolve over time for sustainability, while accounting for the effect of the remaining two factors in our empirical models.

Strategy researchers have consistently noted that a business model is not a static construct. McGrath (2010, p. 248) argues "…business models often cannot be fully anticipated in advance. Rather, they must be learned over time…" Other work reinforces the dynamic nature of business model evolution that occurs through learning and experience in response to the changing environment and customer needs (Rindova and Kotha 2001; Zollo and Winter 2002). Experimentation and learning are arguably even more critical for ventures that seek to fulfill a new customer need that did not exist in the environment, as is the case with HIEs. Therefore, we investigate the moderating effects of age on business model components to influence sustainability. Finally, we suggest that the effects of business model components on financial sustainability are mediated by operational maturity.

2.4.1. Customer Value Proposition: Extensiveness of Core Service Offerings

The customer value proposition (CVP) of a firm is manifested through product or service offering that helps customers to perform a task to fulfill a need, often more effectively, conveniently and affordably (Johnson et al. 2008). For an HIE, the CVP is digital access and exchange of information for health services, that translates into a set of service offerings that can help to facilitate the electronic capture, storage, and dissemination of relevant information and provide connectivity among the various disparate elements of the healthcare ecosystem (Detmer 2003; Walker et al. 2005).

Drawing from the data exchange functionalities discussed in a previous study by Adler-Milstein et al. (2011), we consider five core service offerings for HIEs that are central to its mission: (1) connectivity to electronic health records, i.e., the capability of the HIE to connect to hospitals, physicians, clinics and other stakeholders; (2) exchange of health summaries for continuity of care, that enables customers to access patients' prior clinical information (medication history, eligibility information, lab history, immunization history and clinical care documents) through the HIE's interface; (3) electronic prescribing function (e-prescribing), that helps to transmit prescription-related information digitally between prescribers, dispensers, or pharmacy managers through the HIE; (4) alerts to healthcare professionals that provide medication warnings, alerts for allergies, drug interactions, adverse side effects, and public health related announcements, and help increase safety in healthcare delivery; and (5) clinical decision systems to record, exchange and access

all pertinent clinical information during various procedures and regimens of patient treatment. Adler-Milstein et al. (2011) categorize HIEs into two broad classes: basic and comprehensive, and note that a basic HIE's data exchange functionalities include imaging results, patient demographics, medication lists, discharge summaries, patient demographics, medication and problem lists. A comprehensive HIE would exchange several other types of data, such as public health reports, and physician notes. Our conceptualization extends a basic HIE's data exchange functionalities to the five core services types that helps to profile an HIE's customer value proposition, and that can help the HIE to earn money from its customers by offering a utility-generating set of services to its customers in the founding years.

The five core services provide the initial building block to construct a potentially richer portfolio of offerings in the future by implementing additional functionalities such as a clinical data repository, master patient index, record locator service, telemedicine, medication management, and disease or immunization registries (Overhage et al. 2005; Vest and Jasperson 2010). We select these services as the core CVP because they are aligned to the meaningful use criteria formulated by the U.S. federal government to stimulate the adoption and meaningful use of electronic health records (EHRs) by eligible professionals and hospitals (Blumenthal and Tavenner 2010; Hogan and Kissam 2010). As Adler-Milstein et al. (2011) note, to receive financial incentives for meaningful use of electronic health records, physicians and hospitals will need to engage in health information exchange; and basic and comprehensive HIEs provide different bundles of services that are aligned to the meaningful use criteria. As the HIEs move from basic to comprehensive stages

by providing a range of services to meet the stage-1 meaningful use core (e.g., entry of basic patient data, electronic prescribing, decision support, and the ability to perform information exchange) and optional criteria (e.g., items relating to improved coordination between care settings and the provision of educational and clinical information to patients); the likelihood of participation from different groups of stakeholders in the HIE increases substantially. However, current HIEs are not able to provide all the five core services due to lack of infrastructural and robust data exchange functionalities; Adler-Milstein et al. (2011) find that only 13 HIEs in US are capable of supporting stage-1 meaningful use criteria completely. Thus, to the degree that offering all the core services in the initial periods may not be feasible for HIEs (Vest and Gamm 2010), there is significant variation in the CVP offered by different HIEs.

The influence of core service offerings on sustainability is evocatively illustrated in the case of the failure of Santa Barbara County Exchange in California. Miller and Miller (2007) note that the "lack of a compelling value proposition" was the main cause of the Santa Barbara Project's demise; because the decision makers in the project were not focused on offering "value propositions from utilizing data from multiple sources for improved population health services or more effective pay-for-performance incentives, or from providing consumers with electronic data and software services that could begin to turn patients' data ownership and care self-management into more than industry buzzwords" (p. w578). To the extent that a core service bundle that aligns with market and institutional demands can help the HIEs in generating revenue (Hayward et al. 2007; Vest and Gamm 2010), we expect a

positive relationship between the extensiveness of core service offerings and financial sustainability and operational maturity.

2.4.2. Profit Formula: Revenue Model

The second component of the business model is the profit formula, i.e., the blueprint that defines how the HIE creates revenue for itself while providing value to customers. For an HIE, sale of services is the recurring stream of revenue that can contribute to sustainability, while donations and grants typically provide initial venture funding. The two alternatives for an HIE to monetize its services are (1) a transaction-based model that involves charging a fee for a unit of data or information exchanged, such as a fee per lab report, and (2) a subscription-based model that levies a recurring fee for a specified volume of transactions per time period.

Subscription fee-based revenue models are attractive to both providers and customers. Consumers find subscriptions a convenient way to pay for services consumed regularly, as they alleviate the effort involved with multiple transactions of low value (Danaher 2002). Further, some consumers believe that if they buy a service on a regular basis they might save money. For example, instead of paying a dollar every day for newspaper delivery, consumers pay a subscription of $15 or $20 per month (i.e., often discounted from the total $30 fee). From the providers' perspective, subscription fees assure a constant revenue stream from the customer base and generate recurring cash flow through the continuous or automatic renewal process (Dover and Murthi 2006). Further, subscriptions require that the customer pay a price to access the service, irrespective of actual usage. Often customers pay

subscription fees in advance (as with magazines, newspapers, and cable services); thereby reducing the burden of collecting revenue after the service is consumed. Further, the contractual agreement signed for the subscription helps providers to lock-in customers for a specific period, during which the provider can monitor customer behavior and take strategic action targeted at customer retention. For example, providers have been known to provide incentives or freebies based on customer satisfaction with and response to services (Burez and Van den Poel 2007).

However, despite the advantages that subscription models offer, we theorize that adherence to subscription fee-based revenue models alone can potentially have a negative impact on the sustainability of HIEs. Although they offer predictable, constant revenue streams, subscriptions are not aligned to the principle of generating revenue from every unit of transaction at the initial stage of HIEs within the constraints of limited service offerings. Customers may not commit to subscriptions, if the service offerings are minimal. Indeed, as prior studies suggest, in the business of exchange of information goods, subscriptions need a menu of services bundles with different prices; that helps the seller construct an optional bundling and price discrimination strategy to maximize revenue (Bakos and Brynjolfsson 1999). As anecdotal evidence suggests, in the early stages of organizational evolution, most HIEs have limited services that they can bundle in creative ways.

In contrast, transaction fee-based revenue models can be structured to generate marginally increasing revenue, based on the volume of transactions. The subscription fee-based model is better able to ensure a constant revenue stream with small volumes of transactions as compared with a transaction-based model.

However, at an initial stage when an HIE offers one or two services, the power of subscriptions with minimal service offerings may be low for customers to commit to the subscriptions; whereas, transaction-based revenue models where "what you pay for is what you get" may be more attractive. Thus, the choice of revenue model during the gestation period will influence the viability of the HIE.

2.4.3. Evolution of Business Model Components and Sustainability

We have argued for a direct effect of extensiveness of core service offerings and the revenue model on sustainability. Theoretically, these effects are not as surprising and limited empirical work notwithstanding, our primary interest is to extend this literature by understanding how the evolution of these business model components influences the sustainability of HIEs in their early stages. We investigate business model evolution by theorizing that age conditions the effects of extensiveness of core service offerings and revenue models on sustainability. This is particularly relevant in the US healthcare context that is rapidly undergoing significant transformations triggered by changes in technology, customer expectations and regulation. Policy initiatives such as the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 and the Patient Protection and Affordable Care Act (PPACA) of 2012 are changing the nature of competition and are increasingly requiring healthcare providers to modify their delivery practices. Such an environment demands that a firm uses its learning and "absorptive capacity" to respond to the external environment (Cohen and Levinthal 1990; Lane and Lubatkin 1998). Recent studies argue that acquiring absorptive capacity is a dynamic process that unfolds with a firm's evolution over time. Through the evolution process,

a firm learns to manage its interactions with partners and stakeholders for value creation, and accordingly changes its strategic behavior to reduce uncertainties associated with the value creation process (Malhotra et al. 2005; Zahra and George 2002; Zollo and Winter 2002). To illustrate, describing how two digital businesses (e.g., Yahoo! and Excite) learned and morphed in response to emerging environments, Rindova and Kotha (2001, p. 1273) noted that firms undergo "*comprehensive, continuous changes in products, services, resources, capabilities and modes of organizing*" to sustain themselves in an emerging environment.

To the degree that the value proposition of HIE in the US healthcare setting is not clearly established, the learning process over time is likely to play an important role in their survival. Evidence suggests that HIEs are experimenting and learning to transform their operational strategy to better align with varying customer needs, and then orienting their resources and capabilities for optimal value creation. For instance, early HIEs had perceived EHR connectivity as the best and simplest process for data exchange, and therefore, focused on improving their EHR integration capabilities. Recent HIEs are learning that EHRs may be costly propositions for physicians who wants to participate in HIE activities (Shapiro et al. 2007). Similarly, stakeholders participating in recent HIEs demand a wider and richer service portfolio than was expected from early HIEs (Vest and Jasperson 2010). Therefore, with experience, older HIEs would learn to bundle and structure the service offerings to provide different options to different stakeholders, e.g., a fully loaded service bundle for hospitals, and a less extensive service option for physicians. This may not be the case for a relatively younger HIE that does not have complete knowledge of

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stakeholders' emerging needs. Likewise, with the passage of time, customers learn about the new capabilities that the HIE afford them, and begin to demand greater variety in offerings. Thus, age is expected to have a positive interaction effect on the relationship between extensiveness of core service offerings and sustainability. Therefore, we test:

H1a: *The influence of extensiveness of core service offerings on the operational maturity of an HIE is amplified by the age of the HIE.*

H1b: *The influence of extensiveness of core service offerings on the financial breakeven of an HIE is amplified by the age of the HIE.*

Planning for a rich and effective core service bundle would ensure that an HIE is able to create value from its services as time progresses. However, value creation from services often cannot be fully anticipated in advance due to the externalities involved in the adoption of the HIE's services. Researchers suggest that firms need to learn over time to provide effective service offerings as part of their business models to accrue a constant revenue stream (McGrath 2010). We suggest that as an HIE progresses, some core service offerings have a higher potential to create value compared to others. To investigate the value creation potential of different types of core services, we unbundle and categorize the five core service offerings of the HIEs into *foundational, vendor driven* and *advanced services* based on environmental and contextual considerations relevant to the healthcare setting.

Conceptually, a foundational service is the primary unique function that defines the service provision of the firm. HIEs exist fundamentally to act as "brokers" for facilitating information connectivity and sharing data among healthcare

stakeholders. To the degree that the primary function of an HIE is to provide capabilities of digital data exchange, and exchange basic health summaries of patients (e.g., lab records, imaging results, patient demographics, medication lists, discharge summaries, problem lists and physician notes for a patient) across the participating entities (Adler-Milstein et al. 2011), we classify EHR connectivity and health summaries as the *foundational services* of an HIE. Because foundational services are the raison d`etre for an HIE, these services also satisfy the needs of a wide-range of potential customers, and can be instrumental in generating revenue from all groups of customers.

We define *vendor driven* services as those for whom there are solutions available in the market prior to the arrival of the HIE. In other words, this service is not distinctive or unique, and customers can satisfy the need for the service through alternative mechanisms. Electronic prescribing (e-prescribing) is a vendor driven service offering for an HIE; it predominantly caters to the need of pharmacies in avoiding the overhead of calling back to the physician offices to clarify illegibility, inconsistencies, or formulary adherence of paper written prescriptions (Grossman et al. 2012), and has been in existence since the Medicare Modernization Act of 2003. Revenue generation from the e-prescribing service of an HIE may be challenging because vendors are already providing these solutions in other forms to hospitals and doctors. As the HIE progresses, the push to adopt these vendor driven services in the presence of alternate legacy e-prescribing solutions may deter some customers from participating in the HIE, thereby affecting revenue.

The third category of core services of an HIE are what are labeled as *advanced services*, and include *alerts to providers* and *clinical decision systems* services. Both services require investments by consumers and extensive workflow changes. Alerts to providers are predicated on the availability of data capture systems and algorithms in hospitals or physician offices so that alerts generated from these systems can then be communicated through the HIE to other entities. Clinical decision systems demand that providers implement changes in routines such that the information flow occurs seamlessly through the HIE to take decisions at an appropriate level. In other words, adoption of the advanced services of HIEs require the participating hospital or provider need to change clinical and administrative workflow within the organization (Unertl et al. 2012). Thus, while the availability of advanced services may be attractive to some customers, their revenue generation potential will be limited because of the burden of workflow and administrative changes required within the organization of the participating entity. Moreover, as the HIE progresses, requiring customers to pay for advanced services may deter their participation and further inhibit revenue generation.

Thus, we suggest that foundational services have higher value potential capabilities due to their customer-appeal compared to vendor-driven or advanced services, as the age of the HIE increases. The financial incentives associated with meaningful use criteria for EHRs require physicians and hospitals to be able to exchange health information and summaries (2011); and therefore, the willingness to pay for the two foundational services, e.g., EHR connectivity and health summaries would be high for a majority of HIE customers. In contrast, an HIE's e-prescribing

service may not be attractive to customers because of the availability of alternatives in which they have already invested; and lack of readiness to implement advanced services may dissuade them for adoption. Therefore, we hypothesize:

H2a: *The positive influence of foundational services on the operational maturity of an HIE increases with the age of the HIE.*

H2b: *The positive influence of foundational services of an HIE on financial breakeven increases with the age of the HIE.*

The age of an HIE is also likely to influence the relationship between revenue models and sustainability. As time progresses and the HIE gains more customers with a higher transaction volume, it may find it more profitable to use transaction-based revenue model. At inception and soon thereafter, HIEs have lower transaction volumes, thereby making subscription-based revenue models more attractive. Recent announcements by digital service and content providers such as Verizon and AT&T indicating a shift toward transaction-based revenue models from primarily subscription-based revenue model as the demand for data and bandwidth goes up (Troianovski and Gryta 2012) provides indirect support for the conjecture that HIEs may also find it more sustainable to migrate toward transaction-based models over time as usage of their services grows. Thus, we hypothesize:

H3a: *The age of an HIE moderates the effect of revenue model on operational maturity such that the HIE is more likely to achieve operational maturity when it uses a subscription-based revenue model in early stages and a transaction-based revenue model in later stages.*

H3b: The age of an HIE moderates the effect of revenue model on financial breakeven such that the HIE is more likely to achieve financial breakeven when it uses a subscription-based revenue model in early stages and a transaction-based revenue model in later stages.

2.4.4. Mediation by Operational Maturity

The operational maturity of an HIE reflects its functional progress. As firms advance through different stages from their initiation, their functional specialization and decision making characteristics change with the growth of the firms (Kazanjian and Drazin 1989). The progression helps a firm to gain distinct capabilities, skills and expertise in managing technology as well as other operational aspects of the business. The development of decision making structures helps the firm to address issues related to implementation, and progress towards commercial operations (Gilbert et al. 2006; Liao and Welsch 2008). For example, starting commercial operations requires managers to translate a conceptual business plan into actionable goals. Stakeholder collaborations help the firm to reach out a wider customer base and acquire customers that can pay for services. The operational stages help to develop capabilities to convert resources into products or services, and further hone skills in customer acquisition and management that are crucial for revenue generation. A higher stage of operational maturity reflects increased functional specialization and expertise, and signals that substantial organizational learning has occurred. Collectively, these accomplishments aid the entrepreneurial firm in leveraging its resources and capabilities even more effectively.

We posit that operational maturity mediates the relationship between business model components and financial sustainability, because functional progress and capabilities enable an HIE to provide efficient services and earn revenue. A counter argument could be made that financial breakeven provides the leverage to achieve operational growth. However, we rule out the counter argument because of two reasons. First, higher operational maturity demands that the HIE develops capabilities to convert resources into products or services. Along with resources, capability development depends on trained manpower, efficient processes, and business orientation; that in turn will steer the HIE towards revenue generation. Second, resources needed to achieve functional and operational progress might be raised from initial funds, grants or support from a hospital system; and may not need cash flow from the HIE's revenue. Although financial sustainability may help to mobilize resources for development of capabilities to some extent, but it is not a necessary precursor for development of expertise to manage technology, or the ability to reach out to a wider customer base. On the other hand, without reaching a higher operational maturity stage, an HIE cannot operate to provide services, earn revenue from the services, and achieve financial breakeven from its earnings. In other words, readiness to provide services, and potential to earn revenue from services steer the HIE to be operationally active. As an HIE progresses along the maturity continuum, it is better positioned to achieve financial sustainability. Thus, we hypothesize:

H4:   *The influence of business model components of an HIE on financial breakeven*
        is partially mediated by the operational maturity of the HIE.

As noted earlier, we account for other factors and alternative explanations that might have an influence on sustainability, but for which we do not propose hypotheses. These include the remaining two factors in Johnson et al. (2008)'s framework: (1) IT architecture that reflects the key IT resources of the HIE, and (2) IT access mode that indicates whether the IT processes of the platform support different access options to customers.

2.5. Method

We obtained the archival data used for our empirical analysis from annual surveys conducted by the eHealth Initiative (see Table 7 for the survey questionnaire and coding scheme used in this study). The eHealth initiative is a non-profit organization with a mission to drive improvement in the quality, safety, and efficiency of healthcare through information and technology. The eHealth Initiative survey is designed to collect information regarding the progress of health information exchanges in US, and to track their progress on an annual basis since 2004.

We use a pooled data set for three years of the survey, from 2008 to 2010 for this study. Each year the eHealth Initiative communicates the announcement of the survey through newsletters, mailing lists, and meetings, to a wide range of audiences to elicit responses from national, state, regional and community-based initiatives working on health information exchange. The eHI survey covers almost the entire population of known HIEs in the United States, and is one of the best available datasets to answer the questions posed in this study.

The survey is conducted during the May-June period each year. Incomplete responses, duplicates, or responses from organizations not directly involved with health information exchange are excluded. Responses to the survey are self-reported by participants. The survey is comprehensive in that it seeks to include every health information exchange initiative across the nation. Respondents are typically senior employees of the HIEs such as CIOs, CEOs, program heads, IT heads and other senior executives. The survey has very high response rates in the order of 80-85%; for instance, 198 responses were obtained from 234 HIE initiatives in 2010.

Although the eHealth Initiative obtained responses from 480 entities involved in health information exchange from 2008-2010 (198 in 2010, 152 in 2009, and 130 in 2008), many of these entities were only involved in planning or administrative activities only. For example, some respondents are State Designated Entities (SDE) that have been established as quasi-governmental entities to coordinate and develop statewide plans for the HIE activities. In addition, some respondents did not provide complete information on variables of interest in this study. The usable sample for the empirical analysis is 110 HIEs: 28 HIEs in 2008, 32 in 2009 and 50 HIEs 2010. Seven HIEs in the usable have reported data for all the three years, and seventeen HIEs have reported data for any two years.

2.5.1. Variables

Table 3 provides a description of variables used in this study. Table 4 presents descriptive statistics for the three year pooled data, with pair-wise correlations among the variables. We used the variable financial breakeven *(fin_breakeven)* as the

measure for financial sustainability, which indicates whether the HIE has achieved financial breakeven as a result of operational revenue; primarily from income related to sales of data exchange related services. We use operational maturity *(stagehie)* as the second dependent variable measuring the growth of HIEs on a scale of 1 to 7, following the HIE growth-stage model developed and used by the eHealth Initiative to monitor the progress of HIEs in the United States.

The extensiveness of core service offerings *(coreservice)* is a summative score of the five core services offered by the HIE, e.g., EHR connectivity, health summaries, electronic prescribing, alerts to providers and clinical decision systems. The subscription-fee based revenue model *(subsrev)* is a binary coded variable that is coded as 1 if the HIE is offering only subscription revenues compared to transaction fee based revenues. Likewise, the transaction-fee only revenue model *(transrev)* is a binary coded variable that has a value of 1 if the HIE is offering only subscriptions compared to allowing customers to pay transaction-based fees. We include age of the HIE *(age)* and its interactions with extensiveness of core service offerings and revenue models to study the role of core service and revenue model evolution in sustainability.

The IT architecture (*IT_arch)* variable indicates whether the IT architecture of the HIE is centralized, or is a decentralized model that is supported by collaborators. The IT access mode *(IT_accmod)* variable represents whether the HIE is providing access to physician units through a combination of access options, such as EHRs, portals, websites; or enabling access only through EHR systems.

The models include a robust set of controls in the models to account for other factors and alternative explanations that might have an influence on sustainability, but are not of theoretical interest. We include geographical coverage area (*coverage)*, size *(size)*, time taken for the HIE to be operational *(oprn_time)* in our models; as these are significant structural and operational characteristics of a HIE that may influence sustainability. Prior studies note other factors that may influence sustainability, such as the governance of a HIE by a hospital due to the support from the hospital, and the competition between HIEs in a market that may reduce the revenue generation potential (Adler-Milstein et al. 2010; Grossman et al. 2006). Therefore, we add two control variables representing the intensity of competition that the focal HIE faces with respect to other HIEs in the state *(comptn),* and whether the HIE is governed by a hospital *(hosp_gvrn)*. To the extent that for profit enterprises may have a greater propensity to achieve financial success by being proactive and responsive to profit-maximizing avenues (Malani et al. 2003; Sloan et al. 2001), we include a control variable indicating whether the HIE is structured as a for-profit entity *(forprofit)*.

The *age* of the HIEs ranges from 1 year to 10 years. In the sample of HIEs, average size as measured by number of physician participation is 7400, with maximum of 10000 participating capacity. The time taken to be operational varies from one year to five years. Further, 72% of the 110 HIEs are hospital governed, 39% are for profit HIEs, 62% have coverage to a state or multi-county level.

2.5.2. Estimation Models and Analyses

We used econometric estimation models appropriate for the nature of dependent variable: ordinary least squares (OLS) estimation for the interval scale variable of operational maturity *(stagehie)* and probit estimation for the binary variable financial breakeven *(fin_breakeven)*.

The ordinary least squares estimation is specified by the equation:

$$Y = \beta \, Xi + \varepsilon \tag{1}$$

Where Y is the dependent variable, Xi is a set of explanatory variables, β is a vector of parameters and ε are disturbances.

The probit estimation is specified by the equation:

$$Prob \ (Y' = 1) = \Phi \ (\beta' \, Xi + e_i) \tag{2}$$

Where, Y' is the dependent variable with value of either 1 or 0, Xi is a set of explanatory variables, β' is a vector of parameters, e_i are disturbances, and Φ denotes the normal cumulative distribution function. We report the marginal effects of the estimated coefficients at the mean value of the explanatory variables.

In all the models, we use the three year pooled data of the 110 HIEs. Some models have fewer observations due to missing values in the data. To account for the multiple observations from the same HIEs over time, we report the estimated coefficients with cluster adjusted standard errors of the models, to consider the adjustments for within-cluster correlation of the same HIEs across the three years (Wooldridge 2002).

2.6. Results

Table 5 and 6 presents results of estimation models. In Table 5, we include the summative score of core service offerings *(coreservice)* and its interaction with age, whereas, in Table 6, we disaggregate the five core services (e.g., EHR connectivity, health summaries, e-prescribing, alerts to providers and clinical decision systems) as separate indicator variables and interact each one with age.

We find support for hypothesis H1a; the interaction between core services and age *(coreservice X age)* is positive and significant in the operational maturity model (Column 2, Table 5, $\beta=0.128, p<0.1$). Results do not support hypothesis H1b (Column 1) as the interaction between *age* and *coreservice* is not significant in the financial breakeven models (Column 1 and Column 3).

We find partial support for hypothesis H2a, as the interaction effect of electronic prescribing with age in the operational maturity model is marginally significant and negative (see Column 2, Table 6; $\beta = - 0.079, p<0.1$), but other services' interactions with age are not significant. We find support for hypothesis H2b, as the interaction effect of foundational services (e.g., EHR connectivity and health summaries) is significant and positive in the operational maturity model (see Column 1, Table 6; β *(EHR connectivity X age)* = 0.084, $p<0.1$; β *(Health summaries X age)* = 0.088, $p<0.1$)), but the interaction effects of other services are not significant. The results are similar after including the operational maturity *(stagehie)* in the financial breakeven model (Column 3, Table 6); where the interactions of foundational services are significant and positive, the interaction term of electronic

prescribing and age is significant and negative, and interaction terms of advanced services with age are not significant; thereby providing full support for hypothesis H2b.

Hypothesis H3a is supported, as the interaction between subscription-based revenue model and age *(subsrev X age)* is not significant (Column 2, Table 5) in the operational maturity model, but the interaction between transaction-based revenue model and age *(transrev X age)* is significant and positive (Column 2, Table 5, *β=0.246, p<0.1*). The revenue model-interaction terms (e.g., *subsrev X age* and *transrev X age)* are not significant in the financial breakeven model (Column 1, Table 5). However, when we included operational maturity *(stagehie)* in the financial breakeven model, we find that the interaction between subscription-based revenue model and age *(subsrev X age)* is significant and negative (Column 3, Table 5, *β= -0.073, p<0.1),* whereas, the interaction between transaction-based revenue model and age *(transrev X age)* is significant and positive (Column 3, Table 5, *β=0.086, p<0.1).* These results support hypothesis H3b.

Following the procedure recommended by Baron and Kenny (1986), we find support for the mediation hypothesis H4, as operational maturity is significant and positively associated with financial breakeven in the mediation effect models (see Column 3, Table 5, *β = 0.209, p<0.01).* The Sobel mediation tests indicate that operational maturity mediates approximately 60% of the total effect of the independent variables on financial breakeven.

Among the main control variables, we find that *IT architecture* variable is significant and positive for financial breakeven (Column 1, Table 5, *β = 0.145,*

p<0.1), indicating that a centralized architecture of the IT platform is positively associated with sustainability. Further, we find that *IT access mode* variable is positive and significant for financial breakeven (Column 1, Table 5, *β = 0.238, p<0.01),* indicating that providing access to the HIE's IT platform through a number of options positively influences sustainability.

We also find that geographic coverage is significant and negative for financial breakeven (Column 2, Table 5, *β = -0.176, p<0.05),* and the coefficient of size is significant and positive for financial breakeven (Column 1, Table 5, *β=0.062, p<0.05).* We find that both competition *(comptn)* and time taken to be operational *(oprn_time)* are significant and negative in the models, indicating their dampening effects on sustainability. We did not find any direct effect for *hosp_gvrn* on sustainability. Replacing the *hosp_gvrn* variable with a variable indicating the involvement of hospitals *(hosp_invld,* with high correlation of 0.89 with the *hosp_gvrn* variable) produced similar results. The *forprofit* variable is also not significant in the models, suggesting that the profit structure of the HIE is not a significant driver of its sustainability.

2.6.1. Tests for Bias and Robustness

Because the dependent and independent variables came from the same survey instrument, we conducted Harman's one-factor test to assess potential threats related to common method bias. The exploratory factor analysis yielded multiple factors, several with eigen-values exceeding one. Because no single factor emerged as a dominant factor accounting for most of the variance, common method variance does not appear to be a serious problem. The routine tests for reliability of survey measures

are not applicable because we use formative and binary coded or summative scales for our constructs. In addition, the impact of method variance was tested by creating one marker variable (with all used indicators) and linking it to both independent and dependent variables (Malhotra et al. 2006). The impact of this method variable is insignificant which reinforces the conclusion that common method bias is not a threat to the findings.

We tested for multi-collinearity by computing condition indices for the models. The mean variance inflation factor (VIF) was less than 6 across all models, indicating that multi-collinearity is not a serious concern in the analyses. Since the operational maturity variable does not necessarily measure the maturity stages at equal interval levels, we re-estimated the models with ordered probit and logit specifications that do not assume equal intervals between levels of measurement. The estimation results are similar to the ordinary least squares model specification. We address repeated observations of HIEs across the three years by estimating coefficients with cluster adjusted standard errors that account for the multiple observations across years. Further, we compared the results with and without year dummies in our models and obtained consistent findings, indicating that the year-wise variation of coefficients is not a major concern in the models.

2.7. Discussion

2.7.1. Findings and Contributions

The goal of this study was to understand how the evolution of two central components of a business model, i.e., the customer value proposition reflected

through service offerings and revenue model as profit formula, influence financial sustainability of health information exchanges. We find that the age of the HIE positively moderates the influence of core service offerings on operational maturity and financial sustainability. Compared to new entrants, older HIEs are able to leverage higher value from a number of core services through the experience gained to bundle and structure services for different customers.

We find that HIEs are more likely to achieve operational maturity when they offer a bundle of five core services, and achieve sustainability through higher operational maturity. However, as the HIE's progress, foundational services such as EHR connectivity or health summaries exchange are more influential towards sustainability compared to vendor driven (e.g., electronic prescribing) or advanced services (e.g., alerts to providers or clinical decision systems). Since HIE connectivity and health summaries are aligned to government incentives that customers can potentially leverage for financial benefit, participating customers are also willing to pay for these services to the HIE. While vendor driven services such as electronic prescribing may not be attractive to all customers, advanced services such as clinical decision systems or alerts, may be used less as of now because of difficulties in incorporating into workflows of hospitals and provider; thereby reducing their value for the sustainability of HIEs.

We find that HIEs can achieve operational maturity and financial breakeven when they use subscription-based revenue models in early stages and transaction-based revenue model in later stages. The transaction-based revenue model plausibly generates high revenues for older HIEs due to its attractive returns with increasing

volume of transactions. Although in principle an HIE can earn revenue by both transactions and subscriptions, depending only on subscriptions is not beneficial for sustainability. While at an early stage, within the limitations of minimal service offering, a subscription may be appropriate to earn constant revenue; in long run, transaction-based models are needed to accrue higher revenue to achieve sustainability.

Finally, the operational maturity mediated effect of business model components on financial sustainability indicates that without functional and operational progress, continued sustainability may not be feasible for an HIE. While an HIE may be able to earn high revenue from a handful of key stakeholders in the beginning, continued revenue generation depends greatly on the functional operational progress of the HIE.

This study makes several contributions to the existing information systems literature. We extend prior literature that explores sustainability of new ventures and entrepreneurial initiatives (Goldfarb et al. 2005; Singh et al. 1986) by exploring the relationship between business models and sustainability (Osterwalder et al. 2005). We contribute to the emerging literature on the appropriateness of transaction versus subscription revenue models in the context of HIEs, a new IT-enabled organizational form in the US healthcare that seeks to tie multiple stakeholders and data repositories (Zott et al. 2011). Further, in exploring that modifying a core service bundle to suit to customers' needs as the HIE progresses, we extend the discussions in the recent literature that business models need evolve dynamically, in response to the market

demand, environmental change, and organizational learning with passage of time (Demil and Lecocq 2010).

2.7.2. Limitations and Implications for Research

We acknowledge the following limitations of the study that future research should seek to overcome. First, because of data limitations and the use of a cross-sectional design, our results should be considered associational. Longitudinal data across a larger number of years can help to determine the causal effect of focal variables on the HIE survival. Second, while our sample of HIEs includes ones that have failed to breakeven, it excludes those who have completely failed and shut down. Such a sample is appropriate for our research question because it exhibits variability in financial sustainability, but does not address the question of what factors determine HIE survival. Third, although this study explored evolution of two key components of a digital business model, future studies may explore other factors associated with the evolution of business models, such as key partners, activities, customer segments, and marketing channels. Our finding that the IT-related control variables are significantly associated with sustainability points to a need for further research that adopts a more granular and detailed perspective on the various technology choices that an HIE makes for different customers. Fourth, how the internal operational processes and practices of a firm interact with the components of business models to achieve higher performance is an area of research that needs further exploration.

Several other opportunities exist to extend the work presented here. While our results suggest that the components of business model influence the sustainability of

new ventures engaged with exchange activities; there remains a need to understand the finer-grained processes through which these specific factors influence sustainability. For example, how do different service bundles maximize revenue to influence sustainability? Further, what is the optimum strategy for differentiation of services for different stakeholders? Finally, the quantification of the value that a stakeholder gains from participating in an HIE needs to be established. Exploring these impacts of an HIE on its stakeholders, and the value that each category of stakeholders derives from the use of a sustainable HIE would help to inform the economic rationale behind the value potential, attractiveness for participation, and diffusion of these firms in the US healthcare system.

2.7.3. Managerial Implications

Several managerial and policy implications follow from the findings. We find that core services are important criteria to establish a firm's value proposition in the formative years. Early offering of core services helps the firm achieve sustainability faster, and HIE managers need to take a proactive action towards researching stakeholders' needs and considerations in crafting their service portfolio and organizational capabilities. Moreover, if the core services are aligned to the incentives for stakeholders, there is a higher likelihood of stakeholder participation in the HIE to make it successful. In this regard, our findings indicate that a set of foundational services are more value creating for maturity and sustainability with the progress of HIEs, compared to vendor driven or advanced services. Collectively these findings indicate that HIEs need to focus on specific service portfolios in response to the market demand, while maintaining the adeptness to deliver a richer service bundle to

meet the needs of all categories of stakeholders. The U.S. federal government is releasing criteria for Stage 2 meaningful use in late 2012 that will impose additional requirements on the digital capabilities that hospitals and physicians need to demonstrate. HIEs need to closely monitor these criteria to determine how the service bundle should evolve in response to this environmental change.

Second, HIEs should exercise care in planning their revenue models. While at an early stage, subscriptions may be helpful to gain customers; transaction-based revenue models can generate higher revenue at a later stage. Managers need to think creatively about how to design an appropriate revenue structure, and choose the right revenue model and evolve that based on the structure and characteristics of their firms.

Finally, operational maturity is an influential factor in shaping the capability to earn revenue through operations, and the related efficiency gains. The moderating role of age and mediating role of operational maturity indicate that HIE managers need to approach sustainability as a process that requires making changes in components of business models over time.

2.8. Conclusion

In conclusion, this study explored how the evolution of two components of a business model, viz., customer value proposition and profit formula, influence sustainability of HIEs. We drew on and extended prior literature on design and evolution of business models in an important and understudied setting, that is, the use of IT-enabled data and information exchange in the healthcare system. We find that

higher number of core services increases the likelihood of sustainability for older HIEs. In addition, as the age of an HIE increases, transaction-based revenue models are more appropriate to achieve sustainability than subscription-based revenue models. Finally, we find that business model components influence sustainability through the operational maturity of the HIEs. The study contributes to the existing information systems literature in examining the sustainability of digital business models. Further, this study evaluates transaction-based revenue models in comparison to subscription-based revenue models for HIEs that should receive requisite attention from policymakers and managers involved in planning and designing sustainable HIEs.

2.9. Figures and Tables for Essay I

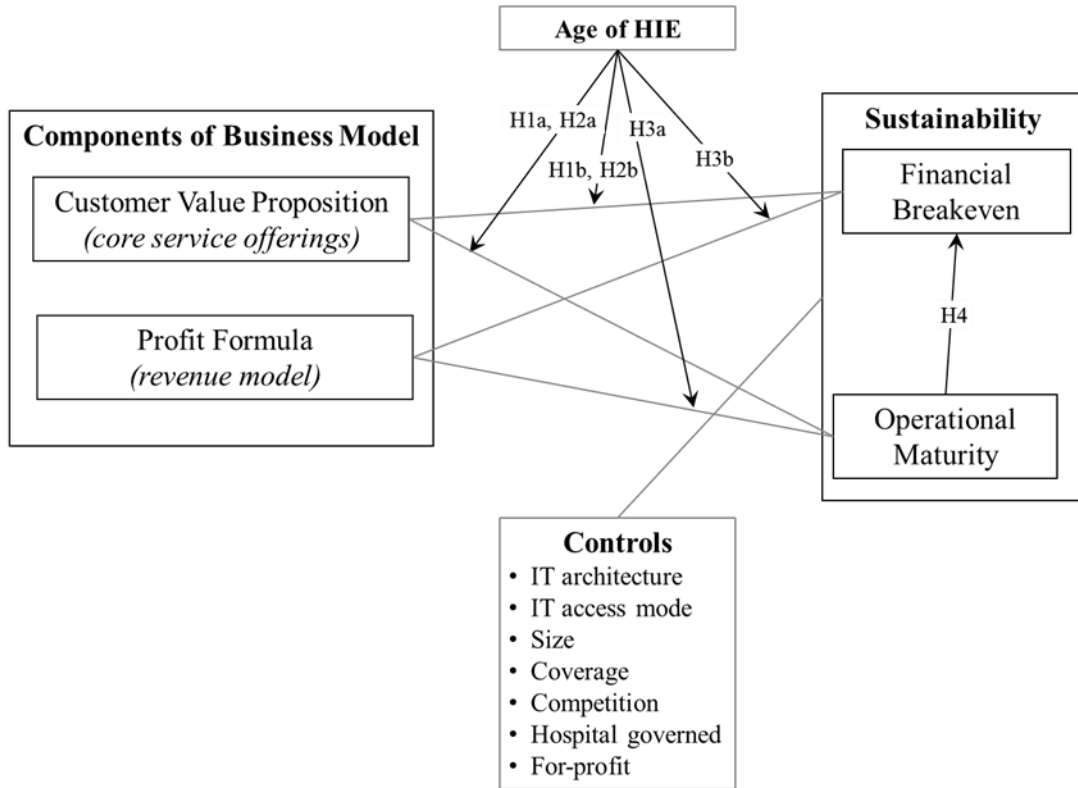Figure 1: Conceptual Model of Evolution of Business Models for HIEs

Table 3: Description of Variables for Essay I

Financial breakeven (*fin_breakeven*)	Whether the HIE has achieved financial breakeven as a result of operational revenue. 1= if the HIE has achieved financial breakeven, 0=otherwise.
Operational maturity (*stagehie*)	The stage of operational maturity of the HIE, from stages 1 to 7 as per the maturity model developed for HIEs. The stages are: 1=HIE initiation, 2=structure formation, 3=plan formulation, 4=plan implementation, 5=technology operation, 6=commercial operation, 7=operational collaborations.
Core service offerings (*coreservice*)	Number of core services offered by an HIE, out of the five core services, e.g., EHR connectivity, health summaries, electronic prescribing, alerts to providers, and clinical decision systems.
Subscription-based revenue model (*subsrev*)	To support the ongoing operations, whether the HIE is charging only subscription fees to clients. 1= only subscription fee based revenue model, 0= other models
Transaction-based revenue model (*transrev*)	To support the ongoing operations, whether the HIE is charging only transaction fees to clients. 1= only transaction fee based revenue model, 0= other models
IT architecture (*IT_ arch*)	Whether the IT architecture is centralized by the HIE or decentralized amongst collaborators. 1= centralized structure of the IT architecture, with all controls and functions with the HIE, 0=decentralized IT architecture with different data, software and standards support for all collaborators.
IT access mode (*IT_accmod*)	Access mode to the HIE's IT platform 1=access through EHRs, portals and websites, 0= access only through EHRs.
Age of HIE (*age*)	The age of the HIE in number of years.
Firm size (*size*)	Size of the HIE measured by the estimated number of physicians to have access to the network enabled by the HIE, in 1000 units.
Geographic coverage (*coverage*)	Dummy variables indicating the coverage area of the HIE is spread to a state level.
Time taken to be operational (*oprn_time*)	Number of years taken by the HIE to reach operational status.
Competition (*comptn*)	Number of HIEs existing in state in the specific year.
Hospital governed HIE (*hosp_gvrn*)	Dummy variable indicating whether the HIE is governed by a hospital.
For-profit (*forprofit*)	Whether the HIE is structured as a for-profit corporation model or limited liability company model. 1=for-profit, 0=non-profit

Table 4: Descriptive Statistics and Pair-wise Correlations for Essay I

	Variables	Obs	Mean	Std. dev	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	*fin_breakeven*	110	0.40	0.49	0	1	1.00																		
2	*stagehie*	100	5.56	1.33	1	7	0.60	1.00																	
3	*coreservice*	110	1.95	1.61	0	5	0.20	0.34	1.00																
4	*EHR connectivity*	110	0.50	0.51	0	1	0.19	0.18	0.66	1.00															
5	*Health summaries*	108	0.32	0.47	0	1	0.04	0.27	0.71	0.22	1.00														
6	*Electronic prescribing*	109	0.31	0.46	0	1	0.01	0.05	0.63	0.31	0.55	1.00													
7	*Alerts to providers*	106	0.34	0.42	0	1	0.15	0.34	0.65	0.29	0.39	0.07	1.00												
8	*Clinical dec. sys.*	106	0.43	0.50	0	1	0.22	0.28	0.66	0.33	0.29	0.18	0.38	1.00											
9	*subsrev*	110	0.68	0.47	0	1	-0.20	-0.23	0.10	0.14	0.00	0.12	-0.01	0.07	1.00										
10	*transrev*	110	0.18	0.38	0	1	0.22	0.21	0.03	-0.02	0.01	-0.05	0.11	0.07	-0.67	1.00									
11	*IT_arch*	110	0.24	0.43	0	1	0.06	-0.01	0.12	0.04	0.11	0.14	0.04	0.05	-0.01	-0.14	1.00								
12	*IT_accmod*	110	0.66	0.47	0	1	0.27	0.20	-0.10	0.02	-0.21	-0.20	-0.03	0.07	-0.11	0.02	0.39	1.00							
13	*age*	110	5.64	2.38	1	10	0.27	0.32	0.12	0.01	0.18	0.02	0.14	0.12	-0.10	0.13	0.00	0.06	1.00						
14	*size*	110	0.74	2.28	0	20	0.22	0.15	0.13	0.06	0.08	0.06	0.11	0.11	-0.06	0.17	-0.01	-0.20	0.16	1.00					
15	*coverage*	110	0.62	0.49	0	1	-0.16	0.10	0.04	0.15	-0.15	-0.09	0.10	0.06	-0.05	-0.04	-0.05	-0.01	0.01	-0.01	1				
16	*oprn_time*	110	2.65	1.19	1	5	-0.21	-0.12	-0.01	-0.04	0.10	0.15	-0.06	-0.18	-0.01	-0.01	-0.07	-0.02	0.18	-0.21	0.14	1			
17	*hosp_gvrn*	110	0.72	0.45	0	1	-0.11	-0.11	0.06	0.10	0.09	0.15	-0.04	-0.10	0.05	-0.09	-0.13	-0.15	0.04	0.03	0.05	0.26	1.00		
18	*comptn*	110	7.04	5.73	1	20	-0.34	-0.26	0.08	-0.07	0.24	0.06	0.09	0.01	0.18	-0.11	0.12	-0.16	0.06	-0.06	-0.07	0.10	0.09	1.00	
19	*forprofit*	110	0.39	0.49	0	1	0.18	0.27	-0.14	-0.09	-0.19	-0.18	-0.05	0.02	-0.21	0.03	0.21	0.57	-0.03	-0.14	-0.06	-0.03	-0.29	-0.21	1.00

All correlations greater than 0.20 are statistically significant at p<0.01.

Table 5: Estimation Models for Essay I

	(1) Probit	(2) OLS	(3) Probit
	Financial breakeven (*fin_breakeven*)	Operational maturity (*stagehie*)	Financial breakeven (*fin_breakeven*)
Core service offerings (*coreservice*)	0.026 (0.036)	0.197* (0.125)	-0.003 (0.030)
Subscription only revenue model (*subsrev*)	0.183 (0.214)	0.107 (1.225)	0.294** (0.118)
Transaction only revenue model (*transrev*)	0.110 (0.260)	-1.572 (1.169)	0.458** (0.224)
Age of HIE (*age*)	0.057* (0.029)	0.129 (0.133)	0.059* (0.034)
coreservice X age	0.035 (0.025)	0.128* (0.075)	0.027 (0.024)
subsrev X age	-0.049 (0.040)	-0.119 (0.153)	-0.073* (0.040)
transrev X age	-0.013 (0.036)	0.246* (0.132)	0.086* (0.047)
Operational maturity (*stagehie*)			0.209*** (0.054)
IT architecture (*IT_ arch*)	0.145* (0.083)	-0.140 (0.326)	0.183*** (0.067)
IT access mode (*IT_accmod*)	0.238*** (0.083)	0.231 (0.360)	0.312*** (0.048)
Firm size (*size*)	0.062** (0.031)	0.025 (0.029)	0.119*** (0.045)
Geographic coverage (*coverage*)	-0.176** (0.076)	0.089 (0.245)	-0.137* (0.073)
Competition (*comptn*)	-0.020*** (0.007)	-0.032* (0.022)	-0.009** (0.004)
Time taken to be operational (*oprn_time*)	-0.065** (0.028)	-0.168* (0.095)	-0.050 (0.031)
Hospital governed (*hosp_gvrn*)	-0.019 (0.089)	-0.135 (0.228)	-0.087 (0.065)
For profit (*forprofit*)	0.004 (0.102)	0.441 (0.416)	-0.224 (0.079)
Constant		5.101*** (1.277)	
Observations	110	100	100
R-squared		0.479	
Adj./Pseudo R-squared	0.412	0.371	0.638
F stat./Chi-square	45.215***	12.248***	44.413***

Standard errors in parentheses
Standard errors adjusted for 69 clusters in models 2, 3, and 70 clusters in model 1
Significance levels: *** p<0.01, ** p<0.05, * p≤0.1
For the probit estimation models, marginal effects at mean of the independent variables are reported
Models include year dummies

Table 6: Estimation Models with Unbundled Core Services for Essay I

	(1) Probit	(2) OLS	(3) Probit
	Financial breakeven *(fin_breakeven)*	Operational maturity *(stagehie)*	Financial breakeven *(fin_breakeven)*
EHR connectivity	0.286 (0.232)	0.142 (0.285)	0.388*** (0.128)
Electronic prescribing	0.411* (0.248)	-0.554 (0.382)	0.355* (0.260)
Health summaries	0.337** (0.155)	0.729 (0.483)	-0.073 (0.252)
Clinical decision systems	-0.007 (0.223)	0.160 (0.341)	-0.212 (0.184)
Alerts to providers	0.451 (0.287)	-0.066 (0.423)	0.148 (0.281)
Subscription only revenue model *(subsrev)*	0.250 (0.167)	-0.177 (0.364)	0.299*** (0.112)
Transaction only revenue model *(transrev)*	0.210*** (0.095)	-0.548 (0.426)	0.352** (0.224)
Age of HIE *(age)*	0.057** (0.025)	0.024 (0.045)	0.026* (0.028)
EHR connectivity X age	0.084* (0.047)	0.005 (0.047)	0.094*** (0.031)
Health summaries X age	0.088* (0.045)	-0.070 (0.085)	0.034* (0.042)
Electronic prescribing X age	-0.061 (0.048)	-0.079* (0.058)	-0.028* (0.044)
Alerts to providers X age	-0.061 (0.048)	0.051 (0.072)	-0.033 (0.039)
Clinical decision systems X age	-0.032 (0.049)	-0.037 (0.063)	0.013 (0.041)
subsrev X age	-0.042 (0.033)	0.010 (0.049)	-0.066** (0.029)
transrev X age	0.175** (0.062)	0.086* (0.061)	0.091* (0.099)
Operational maturity *(stagehie)*			0.232*** (0.084)
IT architecture *(IT_ arch)*	0.145* (0.075)	-0.201 (0.151)	0.205*** (0.057)
IT access mode *(IT_accmod)*	0.235*** (0.086)	-0.032 (0.164)	0.320*** (0.069)
Firm size *(size)*	0.044 (0.030)	0.002 (0.011)	0.070*** (0.025)
Geographic coverage *(coverage)*	-0.181** (0.080)	0.013 (0.127)	-0.118** (0.060)
Competition *(comptn)*	-0.015** (0.007)	-0.021** (0.010)	-0.004 (0.005)
Time taken to be operational *(oprn_time)*	-0.081*** (0.030)	-0.042 (0.044)	-0.075*** (0.019)
Hospital governed *(hosp_gvrn)*	0.037 (0.077)	-0.180 (0.119)	-0.017 (0.067)
For profit *(forprofit)*	0.136 (0.131)	0.223 (0.197)	-0.070 (0.111)
Observations	100	90	90
R-squared		0.396	
Adj./Pseudo R-squared	0.540	0.299	0.680
F stat./Chi-square	128.33***	9.79***	119.86***

Standard errors in parentheses, adjusted for 69 clusters in models 2, 3, and 70 clusters in model 1. Significance levels: *** p<0.01, ** p<0.05, * p≤0.1; For the probit estimation models, marginal effects at mean of the independent variables are reported; Models include an intercept and year dummies

Table 7: Survey Questionnaire and Coding Scheme for Variables for Essay I

Financial breakeven (*fin_breakeven)*	Whether the HIE has achieved financial breakeven as a result of operational revenue. This variable was coded from the question: Have you already broken even as a result of operational revenue along on an income basis? Options: (a) yes, (b) no, (c) do not know (option (c) is available in years 2008 and 2009 only). Coding: 1=HIE has achieved financial breakeven from option (a). 0=all other HIEs.
Operational maturity *(stagehie)*	The stage of operational maturity of the HIE, from stages 1 to 7 as per the maturity model developed for HIEs. Question: What stage is your initiative is in today, as per the eHealthinitiative's HIE maturity framework. Options: Stage 1 to stage 7, with the following descriptions: • Stage 1: Recognition of the need for health information exchange among multiple stakeholders in your state, region or community (public declaration by a coalition or political leader) • Stage 2 : Getting organized; defining shared vision, goals, and objectives; identifying funding sources, setting up legal and governance structures (multiple, inclusive meetings to address needs and frameworks). • Stage 3: Transferring vision, goals and objectives to tactics and business plan; defining your needs and requirements; securing funding (funded organizational efforts under sponsorship). • Stage 4: Well under way with implementation -technical, financial and legal (pilot project or implementation with multi-year budget identified and tagged for a specific need). • Stage 5: Fully operational health information organization; transmitting patient data that is being used by healthcare stakeholders. • Stage 6: Fully operational health information organization; transmitting patient data that is being used by healthcare stakeholders and have a sustainable business model.

	• Stage 7: Demonstration of expansion of organization to encompass a broader coalition of stakeholders than present in the initial operational model.
Core service offerings *(coreservice)*	Number of core services offered by the HIE, from the five core services, e.g., connectivity to EHR, e-prescribing, health summaries, alerts to providers, clinical decision systems. Question: What functionalities of data exchange are you currently providing through your health information exchange initiative? Functionalities: (1) connectivity to electronic health records, (2) health summaries for continuity of care, (3) electronic prescribing functions, (4) alerts to providers, and (5) clinical decision systems. The service functionality questions were given options as (a) currently providing, (b) expected to provide in the future, or (c) we will not provide. The functionalities were binary coded as 1= if the functionality was marked as "currently providing", 0= if the functionality was marked as "expected to provide in the future", and (c) we will not provide was treated as missing value. The exact wordings for the functionalities differ across the years, with multiple questions implying similar functionalities.
Subscription-based revenue model *(subsrev)* and Transaction-based revenue model *(transrev)*	To support the ongoing operations, whether the HIE is charging subscription fees to clients. Question: What mechanisms do you use to support ongoing operations of the health information exchange? Options: (a) transaction fee charged to data users, (b) transaction fee charged to data providers, (c) subscription fees or membership dues to data users, (d) subscription fees or membership dues to data providers, (e) advertising or marketing, (f) fees generated from clinical trials, (g) utility model- fees assessed through state for public service, (h) one-time financial contribution to the health information exchange (donation, etc.), (i) other (please specify). The subscription and transaction fee based revenue models were coded from options (a), (b), (c) and (d). This questions

	have also the following options (with slight variation across years): (i) current revenue source, (ii) planned revenue source within six months, (iii) planned revenue source beyond six months (iv) previous source of revenue. The above questions were used to code both the subscription-based and transaction-based revenue models. Subscription-based revenue model (*subsrev)* coding: 1=only subscription fee based revenue model, options (c) and (d); 0= all other options. Transaction-based revenue model (*transrev)* coding: 1=only transaction fee based revenue model, options (a) and (b); 0= all other options. In both *subsrev* and *transrev* codlings, HIEs offering both revenue models are coded as 0.
IT architecture *(IT_ arch)*	Centralized or decentralized technology architecture implementation. Question: Describe the IT architectural model you are using for your health information exchange initiative. Options: (a) fully integrated repository or database, (b) centralized and homogeneous data repositories (i.e., the same software product), (c) federated with heterogeneous software, (d) federated database with differing data models, (e) have not implemented an architectural model, (f) not sure, (g) other (please specify). Coding: 1=centralized IT architecture model, from options (c) and (d), 0=decentralized implementation model, from options (a) and (b). The options slightly differed across years. The subjective comments in the "others" option was also taken into account to code this variable. Options (e) and (f) were coded as missing point.
IT access mode *(IT_accmod)*	Access to the HIE's platform through EHR systems, or though web or portals. Question: What is the architecture for access by physician practices that do not have EHRs? Options: (a) a centralized portal with its own clinical data repository allowing physicians Web access from their offices, (b) a centralized portal accessing federated repositories allowing physicians Web access from their offices, (c) A remotely hosted EHR operated by the health information exchange itself, (d) "Guest" participation of an EHR of another

	participation of the health information exchange (e) we do not offer access physicians that do not have an EHR, (f) Other (please specify).
	Coding: 1=access to the HIE's only through an EHR, options (c), (d); 1=access through web or portals; coded from options (a) and (b).
	The options slightly differed across years. The subjective comments in the "others" option was also taken into account to code this variable.
Age of HIE *(age)*	The age of the HIE in number of years, data collected from websites and publicly available reports.
Geographic coverage *(coverage)*	The data for the above three coverage area variables are coded from the question: Which best describes your initiative's area of coverage? Options: (a) national level, (b) state level, (c) multi-state level, (d) county level, (e) multi-county level, (f) metro level, (g) city level, (h) non-geographic area, (i) others (please specify).
	Coding: A dummy variables indicating the coverage of the HIE is across several counties and a state from options (d) and (e).
Firm size *(size)*	Question (2009 and 2010 surveys): Please provide the estimated number of physicians who have/will have access to your network, once you are operational (please enter numerical values only, do not use commas).
	Question (2008 survey): How many physicians access your information in your health information access? Options : (a) 0-50, (b) 51-100, (c) 101-250, (d) 251-500, (e) 500-1000, (f) >1000, (g) Don't know.
	Coding: data from these options is converted into a continuous variable at the mid points of the interval scales. The numbers were divided by 1000.
Time taken to be operational *(oprn_time)*	Number of years taken by the HIE to reach operational status.
	Question (2009 and 2010 surveys): How long did it take the HIE to become operational? Options: (a) less than a year, (b) 1 year, (c) 2 years, (d) 3 years, (e) 4 years, (f) 5 or more years.
	Question (2008 survey): Length of start-up period (total time in start-up period): (a) less than a year, (b) 1 year, (c) 2 years, (d) 3 years, (e) 4 years, (f)

	5 or more years. Coding: 1= less than or equal to a year, 2=2 years, 3=3 years, 4= 4 years, 5= 5 or more years.
Hospital governed *(hosp_gvrn)*	This variable was coded from a question that whether hospitals are involved in governance of the HIE.
Competition *(comptn)*	This variable was calculated by counting the number of HIEs in the state that have responded to the survey in the specific year.
For profit HIE *(forprofit)*	Question: Please describe your organization's legal entity model: (a) virtual model-no legal entity, formed under contractual arrangement, (b) non-profit corporation model, (c) for-profit corporation model, (d) limited liability company model, (e) trust, (f) partnership, (g) other (please specify). Coding: 1= for profit organizational form, options (c) and (d). 0= non-profit organizational form, option (b). The options (a), (e), (f) were treated as missing values. If a for-profit was mentioned in the (g) other option, it was coded as 1, and if a government or non-profit was mentioned in the (g) other option, it was coded as 0.

Chapter 3: Service Augmentation and Customer Satisfaction: An Analysis of Cell Phone Services in Base-of-the-Pyramid Markets

3.1. Abstract

IT enabled value added services offer revenue growth opportunities for cell phone providers in markets where intense competition for voice services is resulting in declining average revenue per user (ARPU). However, little is known about the effects of such additional services on customer satisfaction, which is a significant driver of revenue. In this study, we investigate how IT-enabled service augmentation influences customer satisfaction for cell phone services in Base-of-the-Pyramid (BOP) markets, where customers are typically low-income and highly value conscious. We conceptualize value added service and customer care as two components of augmented services. Arguing for price- and relational- evaluations, we develop hypotheses for a substitution effect of value added services, and a complementary effect of customer care, on the relationship between core service and customer satisfaction. Specific to the BOP market context, we further propose a differentiated influence of service augmentation for different categories of providers based on their institutional contexts (e.g., global vs. local providers, and private vs. public providers) and investment strategies (e.g., operating versus capital investments). We empirically examine and find support for the hypothesized relationships using an archival data set from surveys of over 3,400 cell phone customers across 34 providers in seven South Asian countries. Results of our

empirical analysis support the substitution hypothesis for value added service, and complementarity hypothesis for customer care. We also find that the moderating effects are contingent on provider characteristics and investment strategy. We discuss the managerial implications and contributions of the findings.

Keywords: Cell phone service, digital service, BOP market, service augmentation, core service, peripheral services, value added service, customer care, customer satisfaction.

3.2. Introduction

Mobile telephony has grown rapidly in the last few decades, reaching 5.9 billion active mobile phone user accounts, and a worldwide annual revenue of $1.02 trillion in 2011 (Ahonen 2012). Globally, voice service grew by 4% in 2010-2011 accounting for $0.65 trillion in revenue, while value added services such as mobile banking accelerated by 21%, accounting for $0.37 trillion of revenue in 2011 (Ahonen 2012). More than 50% of the world's population has access to a cell phone, with market penetration ranging from an almost 100% saturated market in Europe, to 25% in Africa, and 30% in Asian countries. Not surprisingly, the rapid growth has been accompanied by intensified price competition, resulting in increasingly smaller average revenue per user (ARPU) for voice service providers in some markets. In contrast to the steadily declining voice-ARPU in the past years, IT-enabled value added services such as messaging, internet access, entertainment services (e.g., games, ring-tones, audio and video) and mobile commerce solutions (e.g., maps, banking, purchases, booking systems) are emerging as an important source of potential revenue growth for cell phone service providers (Niculescu and Whang 2012). While managing such digitized services is inherently complex (Rai and Sambamurthy 2006), low-ARPU has left providers with little choice but to engage in value-based service differentiation, further exacerbating the complexity of digital service management.

In this paper, we investigate the effects of the strategic service choices of cell phone providers in base-of-the-pyramid (BOP) contexts characterized by high

subscriber-volume and low ARPU. These markets, consisting of four billion people living with relatively limited resources, with incomes below $3,000 (in 2002 U.S. dollars) in local purchasing power; estimated as $3.35 a day in Brazil, $2.11 in China, and $1.56 in India, are becoming increasingly attractive to service providers. Together, BOP markets have substantial annual purchasing power of five trillion dollars, and are projected to account for 30-32% of the increase in the world population by 2050 (Hammond et al. 2007; Prahalad 2008). The revenue potential of BOP markets has propelled cell phone providers to reduce basic voice prices to make them affordable for low-income customers. As a result, cell phone subscriptions have grown tremendously in some BOP countries, for instance, India experienced a 12% annual growth in 2011, reaching approximately 900 million subscribers by the end of the year (TRAI 2012). Further, to attract low- and middle-income customers, providers are offering innovative value added services, such as mobile money transfer, and agricultural supply disintermediation services (for a review, see Donner and Escobari 2010). Industry reports indicate that currently non-voice value added services contribute to 15-30% of net revenue per user for mobile services in many BOP markets (Delloitte-Assocham 2011), and researchers note that value added services are emerging as significant differentiators across providers (Kim et al. 2010).

Despite the growing emphasis on value added services in BOP markets, providers struggle with chronic churners; for instance, an 11% monthly churn rate in India as compared to 1% to 3% in the United States, the United Kingdom, or Japan (Bellman 2011). A critical strategic question for providers then is the design of an optimal service portfolio that will increase customer satisfaction and prevent chronic

churn. Providers are concerned whether value added services are profitable in the churn-prone market (largely ascribed to competitive ARPUs). Often, justifying investments for advanced value added services, such as next-generation internet connectivity or location services, which need large outlays, becomes difficult. Some question whether value added services are perceived as unnecessary by customers (Reinartz and Ulaga 2008). Therefore, cell phone service providers need to understand the effect of the additional service offerings on customer satisfaction (Ahn et al. 2006; Kim et al. 2004) to develop appropriate strategies to operate in the BOP markets (Karamchandani et al. 2011).

In this study, we investigate how service augmentation enabled by IT influences customer satisfaction for cell phone services in BOP markets. We conceptualize two dimensions of IT-enabled "service augmentation": (1) the "value added service" component, that includes the additional offerings beyond the core service product (Bolton et al. 2000), and (2) the "customer care" component that reflects the enhanced support provided through information technology (IT) enabled customer service management systems (Orman 2007; Ray et al. 2005). Based on theoretical arguments for price- and relational- evaluation effects, we develop hypotheses for a substitutive effect of value added services, and a complementary effect of customer care on the core service and customer satisfaction relationship. Grounding our logic in the BOP market context, we predict and test for the differentiated influence of service augmentation for global vs. local providers, private vs. public providers, and providers' investment strategy (e.g., operating versus capital investments). We use a unique archival data set constructed from a survey conducted

in 2008 by a leading market research firm, and extended by matching observations from other data sets. The survey has 3,542 cell phone user respondents across seven South Asian countries (India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and Maldives), that represent the base-of-the-pyramid (BOP) markets. Results of our empirical analysis support the substitution hypothesis for value added service, and complementarity hypothesis for customer care. Thus, we are able to isolate how satisfaction with different elements of the service bundle relates to overall customer satisfaction. Further, we find that the moderating effects are contingent on provider characteristics and investment strategy. We discuss the managerial implications of the findings and contributions of the study.

3.3. Prior Literature

Customer satisfaction is an important outcome measure for cell phone service providers. Prior research has established customer satisfaction as a key metric of service performance (Anderson et al. 1994; Fornell 1992), that in turn has positive effects on usage behaviours and levels (Bolton et al. 2000), revenues (Rust et al. 2002), and cash flows (Gruca and Rego 2005). In the context of digital services, prior studies have examined the antecedents of customer satisfaction with software products (Krishnan and Subramanyam 2004), enterprise software systems (Ramasubbu et al. 2008), business-to-consumer channels (Devaraj et al. 2002); and the influence of customer satisfaction on firm performance (Aksoy et al. 2008; Fornell et al. 2009; Fornell et al. 2006; Tuli and Bharadwaj 2009). However, none of these studies investigates the relationship between service augmentation and customer

satisfaction in the context of digital services in BOP markets. Our work seeks to address this gap.

Existing research has explored the influence of two dimensions of services on customer satisfaction: core and peripheral. The core service is conceptualized as the "the part of the service we think of when we name the service" (p. 258, Iacobucci and Ostrom 1993); and the peripheral dimension refers to the attributes that explain how the service is delivered and supported (Bitner 1990). Prior studies demonstrate that both core and peripheral attributes are positively associated with overall service quality, customer satisfaction and revenue (Anderson et al. 2008; Butcher et al. 2003; Chase and Stewart 1994; McDougall and Levesque 2000). This is because providers undertake efforts to improve quality of the core service as it defines the service providers' business, whereas peripheral services ensure that the core service is delivered efficiently and effectively

In contrast to core and peripheral services, value added service refers to any additional offerings beyond the core service product that enhances the consumption of the core service, and is conceptualized as a part of augmented service offerings (Ozment and Morash 1994; Storey and Easingwood 1998).   Providers often choose to expand the core service offering into a richer portfolio as a source of differentiation and additional revenue. For example, airlines offer extra leg space or a comfortable seat at a higher price, and hotels bundle breakfast with a higher room rate. Some argue that due to higher customer expectations from extra services that are charged for, customer satisfaction from these services may be less than anticipated (Anderson et al. 2008).

Prior research in the context of cell phone services has studied the interaction between voice and Short Message Services (SMS) – a common value added service for text messaging (see Andersson et al. 2009; Grzybowski and Pereira 2008; Kim et al. 2010). Findings with respect to a substitution or complementary impact of SMS services on the pricing and revenue of voice services are equivocal. Although some studies highlight the importance of voice or core service on customer satisfaction with cell phone services, to suggest that high quality connectivity has a positive association with higher levels of customer satisfaction (Gerpott et al. 2001; Kim and Yoon 2004), our overall understanding of the impact of value added services on indicators of service performance such as customer satisfaction is limited.

3.4. Theory and Hypotheses

We ground the theoretical conceptualization for this study in prior work on the augmented service offering (ASO) model (Grönroos 2000) and on the foundations of service dominant logic (S-D logic) (Vargo and Lusch 2004; 2008). Following prior work (Anderson et al. 2008; Krishnan et al. 1999), we model overall customer satisfaction as a function of satisfaction with the components of service to suggest that core, peripheral and augmented service exchanges exhibit independent and interactive effects on customer satisfaction (Figure 2 shows the conceptual model). Invoking the specific context of BOP markets, we further assert that the interactive effect of service augmentation is differentiated by provider characteristics (e.g., global vs. local providers, private vs. public providers), and contingent upon provider's investment strategy (e.g., ratio of operating and capital investments).

The ASO model includes core service and peripheral services as the main components in the integrated package of service exchanges, along with a set of service-supporting activities (e.g., customer interaction and communication, service delivery, branding, and promotion). As we note earlier, conceptually, a "core" service is defined by the distinctive and fundamental value received by customers from an offering (e.g., a restaurant offers a meal as a core service, a hotel provides a room), whereas "peripheral" services are facilitative or ancillary to the core service (Bitner 1990; Iacobucci and Ostrom 1993; McDougall and Levesque 2000).

We extend the existing ASO model to include "augmented services" as a third dimension along with core and peripheral dimensions, to the integrated package of service exchanges. We define augmented services as the "extra enrichment to the core service consumption" that is differentiated from other service-process-supporting activities by two attributes: one, dependency on the existence of the core service, and two, value addition or enhancement to the consumption experience of the core service. Augmented services may require customers to pay, or may be offered at no charge.

The S-D logic asserts that service exchanges are encounters during the service rendering process between the provider and the customer that create value for both parties (Lusch et al. 2008; Vargo and Lusch 2008). Prior literature suggests that customers assess all categories of service interactions to cumulatively evaluate their consumption experience and subsequent satisfaction (Bitner and Hubbert 1994). To the extent that service augmentation is dependent on the core service for its delivery, these services are likely to be evaluated in an interdependent way with the core

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service. As shown in Figure 2, we include value-added service and customer care as two forms of service augmentation. Due to the price sensitivity of customers and in the presence of infrastructural and quality issues in BOP markets, we theorize that the value added service component has a substitutive effect on the core service-customer satisfaction linkage. By contrast, the customer care component complements the relationship between the core service and satisfaction via its relational effect and service enhancement that comes free of charge to the customers.

3.4.1. Dimensions of Service Exchanges for Cell Phones

The prime purpose of a phone is to make a call. Therefore, "connectivity" is the core service for cell phone providers and is reflected in network connection attributes, such as coverage, strength, call drops, and voice quality during calls. Peripheral services support the initiation, offering and management of core service. We include two peripheral services in the conceptual model: (1) sale and presale process, and (2) the billing process.

Among augmented services, the value added service (VAS) component is the price-based additional service offering to an existing voice plan. These offerings typically provide four forms of additional functionality for cell phone customers: (1) communication through text based messaging services such as SMS and MMS, (2) entertainment, for example, songs, games, cartoons, or videos, (3) provision of updated information, including news, and weather, and (4) facilitation of information exchange, such as banking, finance or brokering services. Often, a set of value added service suppliers who create content, design applications, and integrate these services

with the network enable these services for the cell phone service provider, while the provider takes responsibility for network infrastructure, management capability, brand management, and marketing. Although the provider might have a financial relationship with suppliers, exclusive contractual arrangements to enforce service quality parameters are hard to find in such collaborations (Chen and Cheng 2009).

In contrast to VAS, the customer care component is typically provided free of charge to the customers. Customer care is focused on supporting customers for resolving issues with service delivery, and is characterized by three attributes: (1) easy access using interactive voice response menu; (2) efficient response with an appropriate solution to the customer's issues; and (3) the ability and courtesy shown by customer care representative to understand and deal with customer's issues (Chesbrough 2007; Ostrom 2005). Either the service provider firm directly handles customer support, or if outsourced, the provider frequently monitors and controls the quality of customer care activities.

3.4.2. Direct Effects of Service Exchanges

Existing literature in service management suggests that both core and peripheral service failures can be detrimental to service quality and customer satisfaction evaluations, with robust empirical evidence for the positive influence of core and peripheral services on customer satisfaction (Anderson et al. 2008; Butcher et al. 2003). Similarly, prior studies note that customers prefer enhanced service offerings that might facilitate and support the core and peripheral services, or assist in efficient delivery of the services (Anderson et al. 1994; Grönroos 2000). We suggest

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that customers derive value from core, peripheral and augmented service exchanges, although the value perception of the customer from these services may be different depending on the service quality (Woodruff and Flint 2006). Extending arguments in the existing literature, we predict that satisfaction with each of the three categories of service exchanges, viz., core, peripheral and augmented services will influence customer satisfaction.   Thus, we test:

H1a: Satisfaction with core service is positively associated with overall customer satisfaction.

H1b: Satisfaction with the value added service component of service augmentation is positively associated with overall customer satisfaction.

H1c: Satisfaction with the customer care component of service augmentation is positively associated with overall customer satisfaction.

H1d: Satisfaction with the presales and sales component of peripheral services is positively associated with overall customer satisfaction.

H1e: Satisfaction with the billing component of peripheral services is positively associated with overall customer satisfaction.

3.4.3. Moderating Effects of Service Augmentation

S-D logic asserts that service exchange is a culmination of transaction and relational interaction between customers and providers (Lusch et al. 2010). Researchers distinguish between transactional and relational exchanges based on their contractual contexts. A transactional exchange is an economic or monetary trade with clear expectations, often established through legally framed contracts. Relational

exchanges stem from the socio-emotional base that underlies expectations of ideals, reciprocity, respect and support in the exchange process (Macneil 1985; Rousseau 1995). To the extent that value added services (VAS) are "monetized" by providers and are being "paid" for, they are more likely to be perceived as legal-contract based transactional service exchanges. By contrast, customer care is free and thus, a relational service exchange that is established through a reciprocal relationship between customer care representatives and customers. Further, as noted, VAS are additional offerings with enhanced features, whereas customer care is construed to be support oriented. Although both services are delivered and offered in the same IT-enabled cell phone service context, due to the inherent price- and relational-differentiation, we suggest that they yield different overall value propositions for customers.

Customers evaluate VAS stringently as they are offered at a price. Prior research suggests that price premium based transaction specific satisfaction is not perfectly correlated with overall satisfaction, since service quality vis-à-vis price-premium assessment varies with each additional experience the customer has (Jones and Suh 2000; Parasuraman et al. 1994). Therefore, when the quality of a VAS is low, additional consumption would reduce overall satisfaction of customers. Because cell phone service providers typically do not enforce quality parameters on the VAS that are offered by third party suppliers (Chen and Cheng 2009), the quality alignment and seamless integration of value added services with the core service of cell phone (e.g., connectivity) may pose significant challenges. For example, a low quality data-service enabler not only reduces the speed of browsing, but also keeps the phone

engaged for a longer duration, making it unavailable for calls. A virus-laden game, or a poorly integrated location based service (e.g., map or navigation) may make the phone unusable for a period. Thus, paid VAS that command a premium might influence the overall service consumption negatively, under a regime of stringent assessment by the customer, and without specific quality reinforcement mechanisms on the part of the provider.

In the context of BOP markets, the negative influence of value added services on the relationship between core service and customer satisfaction could arise for a variety of reasons. First, in BOP markets, avalability of resources for investment to support and manage VAS for the huge subscriber base (Gruber 2005) is a challenge for most service providers, and particularly so when the infrastructure requirements are high. High subscription density in certain areas requires high bandwidth capacity. While most service providers in these markets generally adopt an aggressive customer acquisition strategy, they rarely allocate additional investments corresponding to an increase in the number of subscribers enrolled in the services. Further excerbating this situation, information and entertainment oriented VAS increase demands on bandwidth, especially when the bandwidth dependencies or streaming technologies for these services are not optimized (such as, changing the channel through frequency or band, or handoff prioritization in wireless cellular networks). As a result, customers frequently face slow speeds, delays, drops, and overall low quality service delivery (Sgora and Vergados 2009).

Second, industry reports note that service providers often try to offset the low voice-ARPU through high-priced VAS (Telecoms.com 2009). They aggressively

market a number of value added services to boost revenue, without adequate strategic consideration of the impact on customers. For example, providers may automatically enroll subscribers in value added offerings with complex opt-out options, such as the requirement to call a number and follow specific instructions to stop the service. Unless the customer is alert, the failure to opt-out leads to a recurring charge in subsequent billing cycles. Such a "push sell" creates a burden on the customer to monitor subscription-add-on options to the core service, and likely has a detrimental effect on overall customer satisfaction.

Finally, prior literature shows that customers' decision of whether or how much to buy in one category depends on the corresponding decision in a related category (Niraj et al. 2008; Seetharaman et al. 2005). Thus, from the consumer decision-making perspective, when customers are exposed to cross-category dependencies, they often substitute the basic options with the augmented options. In the case of cell phones, a prior study finds that SMS and voice service are modest substitutes, with a 10% increase in the price of voice minutes inducing about a 0.8% increase in the demand for SMS (Kim et al. 2010). In other words, SMS decreases the consumption of voice service. Likewise, other value added services, such as emails or chat features, result in a reduction in the consumption of core voice service. As the core service consumption decreases, the resulting experience and satisfaction associated with the core service might decrease due to limited consumption experience.

Negative media coverage of a poorly functioning map application (app) in a new release of Apple's iPhone in 2012 offers an evocative illustration of the proposed

negative moderation effect of VAS on the relationship between core service and customer satisfaction. The app showed wrong directions, misplaced locations, and was poorly integrated into the iPhone (Pogue 2012). Apple used VAS enablers, such as TomTom (a company developing maps and global positioning systems), Yelp (a company providing map based directory and rating services on internet), and additional services from a dozen other companies. Subsequent to release, when the map app did not function properly, customers were dissatisfied; and Tim Cook, the chief executive officer of Apple had to apologize to pacify disgruntled customers. Although the map apps failure occurred in the United States rather than in a BOP market, this example illustrates the generalizability of our arguments beyond the BOP market context.

In sum, we suggest that infrastructural and quality issues in BOP markets, an aggressive approach to marketing high-priced VAS so as to enhance revenue, cross-category substitution effect of certain VAS on core service usage, and poor integration of value added services with the cell phones, negatively influence the price-sensitive evaluation of these services by customers. In other words, in the presence of high satisfaction with VAS, the influence of the core service on overall customer satisfaction is attenuated. Based on these arguments, we hypothesize:

H2a: *Satisfaction with the value added service component of service augmentation has a negative moderation (substitution) effect on the association between satisfaction with the core service and overall customer satisfaction.*

In comparison to value added services that are monetized by the seller, customer care is relational and unpaid augmentation for customers. Existing studies suggest that relational components during service delivery inherently create a positive experience for the customer (Chen and Dubinsky 2003; Sirdeshmukh et al. 2002). For example, providers try to identify service gaps and potential solutions to customers' issues through customer care, thereby creating a positive experience for the core service consumption (Khanna and Palepu 1997; Xu and Shenkar 2002). We extend these existing discussions in the literature to sggest that customer care component of the service augmentation creates a positive moderation effect on the core service – customer satisfaction relationship. The underlying mechanisms are two-fold: (1) a personnel relational effect on the customer's core service experience, and (2) the IT based system improvement for customer support.

The personnel relational effect is an outcome of the highly trained and effective manpower deployed in customer care, while the IT based improvement is a result of the use of IT based customer management systems. A key strategy followed by service providers for the provision of customer care of the recrutitment of appropriate customer care personnel, and training and motivating them to be responsive and efficient in resolving customers' issues (Gonsalves et al. 1999; Piccoli et al. 2004). IT based systems such as pre-recorded voice response, call scheduling and menu based response systems help customer care to address customer's issues efficiently (Khanna and Palepu 1997). Trained customer care personnel use knowledge repositories designed for the purpose of rapid response to customers' issues (Kankanhalli et al. 2011). Using IT based systems, the provider firm can

overcome service failures such as customers waiting in line, or customers being transferred to multiple lines, or the experience of talking to an employee who is not not empowered to provide service (Lusch et al. 2008).   Thus, customer care is targeted at improving the efficiency and effectiveness of customer service in responding to the customer needs and resolving their issues.

The personnel relational effect and IT based support systems used by customer care act in an interrelated way to create a positive effect on the consumption of core services.   Efficient and effective customer care creates a long-lasting perception that the provider is proactive to provide solutions to customers, that motivates the customer to participate with the provider's value creation process within the service setting (Dong et al. 2008). Therefore, we suggest that the customer care component of service augmentation complements the satisfaction derived from the core services, and hypothesize:

H2b: Satisfaction with the customer care component of service augmentation has a positive moderation (complementary) effect on the association between satisfaction with the core service and overall customer satisfaction.

3.4.4. Institutional Contexts of BOP markets and Service Augmentation

While BOP markets are attractive to multinational companies due to the robust market potential, multinationals are frequently challenged by "institutional distance" in BOP markets, i.e., the differences between institutional settings, formalized laws, regulations, and distinctions in monitoring and enforcement approaches utilized in developed and BOP market settings (Xu and Shenkar 2002).

As has been widely documented, BOP markets suffer from the deficiencies of under- or un-developed formal institutional structures, such as a lax property rights regime, difficulty in enforcing contracts and laws, and bribery inflicted regulating bodies, that are very distinct from those in more developed nations (Khanna et al. 2005; London and Hart 2004).

S-D logic suggests that institutional structures of a market create a unique context for services, and providers respond to the institutional settings differently in offering their services (Vargo and Lusch 2008; Lusch et al. 2010). A market with high institutional distance for the seller, such as a BOP market, creates implementation and execution challenges for global service providers compared to local providers. Even though some global providers attempt to offer innovative value added services suited to the needs of customers in these markets, such as money transfer through cell phones, or agricultural supply chain disintermediation services (Gruber and Verboven 2001), often, the regulatory framework creates a barrier for success of these services. Due to implementation and execution challenges, providers often fail in seamless service delivery that in turn reduces customer satisfaction.

In comparison, local providers have greater indigeneous knowledge and deeper understanding of the institutional context, and therefore can operate with relatively more ease in these markets. In general, local providers may have limited ambition compared to the worldwide customer acquisition plans of global providers for competing on a service differentiation strategy. As a result, local providers often wait for the market to mature before offering new or value added services; thereby offsetting the barriers posed by the institutional context for new services.

Similar to global providers, private service providers, by virtue of an aggressive customer acquisition process are likely to be challenged by the BOP institutional contexts more compared to public providers. Public providers are largely controlled by the state in these markets, with state-appointed chief executives from the bureaucratic cadres or with political affiliations. Bureaucracy inflicted public providers are limited in their product scope, growth plans and market orientation; causing them to respond slowly to market needs and trends, compared to private counterparts.

The widely discussed case of M-PESA, a mobile-phone based money transfer service, exemplifies the institutional distance challenge in BOP markets. M-PESA is currently offered by the global provider Vodafone in Kenya; with plans to extend to Tanzania, India and Afghanistan. Although M-PESA was launched by Safaricom, an affiliate of Vodafone, in March 2003 in Kenya; the institutional context and bank-government lobbies against the global provider posed significant difficulties for the uptake of M-PESA for over five years in Kenya. Vodafone is facing similar difficulties in other three countries, although the value potential of the service in a BOP market was recognized as early as 2003 (Hughes and Lonie 2007).

Likewise, the example of an Indian provider, Bharti Telecom's outsourcing of network, infrastructure and operational services to global quality solution providers demonstrates a "lesser institutional distance" case in favor of a local provider. Bharti's competency lies in understanding customers' requirements, and driving the unique outsourcing collaborations to be successful in the Indian institutional context (Martínez-Jerez and Narayanan 2007). Therefore, the company decided to outsource

its capital-intensive network services, while focusing on offering additional VAS such as music services through cell phones to create supplementary revenue streams. As Agarwal and Weill (2012) describe, Bharti Telecom strategically chose to retain customer intimacy because the CEO believed it was important to know the "smell" of the customer.

Thus, we suggest that the challenge of confronting BOP markets is intensified due to the institutional contexts for global and private providers. Value added services face implementation issues and inefficient deliveries due to the institutional distance constraints. As a result, the extent to which satisfaction with VAS contributes towards reducing the strength of the association between satisfaction with the core service and overall customer satisfaction is higher for global and private players, than local and public providers, respectively. Therefore, we hypothesize:

H3a: *The substitution effect of satisfaction with value added service on the association between satisfaction with the core service and overall customer satisfaction is higher for global providers than for local providers.*

H3b: *The substitution effect of satisfaction with value added service on the association between satisfaction with the core service and overall customer satisfaction is higher for private providers than for public providers.*

Global providers typically have multi-national experience in customer support services that is unavailable with local providers. Similarly, capital availability with global and private providers faciliates the establishment of customer care centers in high population density segments of BOP markets with a strategic plan to gain high

market realization (Prahalad and Hammond 2002). Global and private players often focus on a highly efficient and effective customer care with large investments for expedited take-off of their services.

The case of Vodafone's entry and take-off in India is an example of leveraging a customer support strategy in a BOP market. In 2007, Vodafone entered the Indian cell phone market, with the acquisition of a 67% stake in Hutchison Essar – a provider mainly operating in large metropolitan areas such as Mumbai, Delhi and Kolkata. Initially, Vodafone built up the existing base of Hutchison Essar and strengthened its business in the densely populated urban cities of India, with a strong focus on customer care to establish a reputed customer friendly brand. Once its reputation was established, Vodafone expanded to the rural areas to gain a larger customer base, with very low ARPU models, such as a $0.01 charge per minute airtime, $3 sim cards, and a $0.25 recharge system. While sophisticated users in cities provided high revenue, the rural areas helped to gain customers, allowing Vodaphone to reach a 150 million customer base in as little as four years (Medianama Report 2011). Similar aggressive market penetration strategies have not been observed in cases of local and public providers in India, such as the Mahanagar Telephone Nigam Limited (MTNL) or Bharat Sanchar Nigam Limited (BSNL) – two prominent public providers in India.

While global and private players use customer care as a competitive strategy based on service differentiation, local and public providers suffer from deficiencies of good customer support, partly due to lack of funding, expertise and experience in customer support management. Thus, we expect that the global and private players

will be able to leverage the complementary effect of satisfaction with customer care more than the local and public providers. We hypothesize:

H3c: *The complementary effect of satisfaction with customer care on the association between satisfaction with the core service and overall customer satisfaction is higher for global providers than local providers.*

H3d: *The complementary effect of satisfaction with customer care on the association between satisfaction with the core service and overall customer satisfaction is higher for private providers than public providers.*

3.4.5. Investment Strategy and Service Augmentation

The investments of cell phone service providers can be divided into two broad categories: (1) capital investments (capex), made for acquiring network infrastructure, cabling, fibre, new equipment, installation costs, license fees, software, network management systems, and non-telecommication related costs such as buildings and furniture; and (2) operating investments (opex), that include costs related with the operation and use of the network, service management, support, network maintenance, fault reparation, and customer support.

Limited availability of basic infrastructure in BOP markets demands that service providers plan for large infrastructural investments and associated capex outlays. For example, many areas of the BOP markets lack access to electricity, where cell phone providers have to establish captive power plants for their network operations, adding to the capital infrastructure cost. Furthermore, emerging technologies, such as 3G or 4G demand large infrastructure investements; for

instance, the worldwide invesments for 3G network roll-out in last decade were estimated to be $300 billion, of which $100 billion were in license fees and $200 billion were in network installation and upgrade costs (Ahonen 2012).

Telecom providers' investment behaviors often depend on immediate margins (Jeanjean 2012). To the degree that the immediate cash flow from core cell phone services BOP markets is low due to the low ARPU, providers face weak financial returns in the initial few years. Some plan for higher operating investment when the initial capex investment starts earning returns. As a result, opex investments are often deferred, specially when investors demand financial stability at an early stage of operations. In addition, due to the initially modest customer base and high customer churn, sales, general and administrative operating expenses remain slow (Lebourges et al. 2012). However, the technology operations demand a higher quality of service as soon as a provider starts operations; that has a direct bearing on the allocation of operating expenses. Therefore, balancing opex to capex investments becomes a challenge for many providers.

The relative contribution of capex and opex to the core service delivery capability of the provider varies. Whereas a significant portion of the capex outlay is utilized to establish the core service of network connectivity to customers, only a small portion of the opex is used for the functioning of the network that aids the delivery of core services. In comparison, a significant portion of opex is used for value added service and customer care; that include service costs, value added service franchise costs, human resources costs such as salaries of employees, support and service of IT based communication infrastructure for customer service, and non-

telecom-related costs such as air-conditioning, light, heating, rent for floor-space rent. Additionally, opex allocations are typically utilized to train employees, and monitor quality of value added services through rigorous testing.

It follows then that capex outlay is necessary for cell phone service providers to provide high quality core service, while high opex outlay helps to improve value added and customer care services. Therefore, as a provider balances the investments, and increases the opex to capex ratio, the resulting improvements will be reflected in offsetting the negative effect of value added services, and amplifying the complementary effect of customer care. Thus, we hypothesize:

H4a: *Providers will experience lower substitution effect of satisfaction with value added service on the association between satisfaction with the core service and overall customer satisfaction, when they increase their operating investments in proportion to capital investments.*

H4b: *Providers will experience higher complementary effect of satisfaction with customer care on the association between satisfaction with the core service and overall customer satisfaction, when they increase their operating investments in proportion to capital investments.*

3.5. Method

3.5.1. Data and Variables

The data set for this study was constructed by matching observations across multiple data sources. The main data source is a survey conducted by a leading market research firm headquartered in India. The market research firm administered an online survey to cell phone users across seven South Asian countries that represent BOP markets (India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and Maldives) in 2008. The firm validated the survey telephonically for about 50% of the respondents by dialing the mobile numbers that respondents shared in the online survey. The surveys covered 3,542 respondents who rated 34 mobile phone service providers in the seven countries. We coded the variables for this study from the survey (see Table 11 for the survey items, coding scheme for variables, and Cronbach alphas for the multi item variables). Second, we matched survey response with data on provider characteristics (e.g., global, local, private or public) from publicly available sources and reports. India has maximum number of cell phone providers (13), followed by Pakistan (7), Bangladesh (5), and other countries (Sri Lanka-4, Nepal-2, Bhutan-1, Maldives-2). Third, financial data, e.g., operating investment, capital investment and annual revenue data for providers was collected from TeleGeography reports. The finance variables are lagged by a year, e.g., for the year of 2006-07.

Table 8 provides a description of variables used in this study. The dependent variable in our models is SATO, a single item measuring the overall customer

satisfaction with the current mobile service provider. Prior research suggests that overall customer satisfaction is a robust indicator of service performance in IT-enabled service settings (Kekre et al. 1995; Ramasubbu et al. 2008), and is an appropriate measure of service outcome in the cell phone context with a wide customer base.

The five key independent variables measure satisfaction with the core service (SATCONN), the two dimensions of augmented services (value added service: SATVA, customer care: SATCUST) and the two components of peripheral services (sales and support: SATSALE and billing account: SATBILAC). Our use of these independent variables focusing on different aspects of customer satisfaction is consistent with the approach in prior work (Krishnan et al. 1999).

We controlled for demographic characteristics of the customers, such as age (AGE), gender (GENDER), monthly household income (HH_INC), and mobile user's education (USR_EDN). We include a control variable measuring the average wait time on hold in minutes before the customer care response (WTIMECR), in the models to account for any influence of systemic service delays or interruptions on customer satisfaction. This is a proxy measure for service quality.

Table 9 provides descriptive statistics and correlations between the focal variables. Survey respondents' age ranges from 13 years to 72 years, with an average age of about 27 years. Approximately 87% of respondents are male. The average monthly income is approximately 3,500 in local currencies (e.g., Rupees 3,500 in India). The average education of users is a college degree.

In terms of provider charactersitics, there are total 19 global providers, 15 local providers, 17 private providers, and 7 public providers, out of total 34 providers in our sample. The total annual revenue of the providers varies from $0.01 billion to $0.8 billion. The variable measuring opex to capex ratio (OPCAP_R) ranges from 0.23 to 3.24, with an average of 0.98 across providers.

3.5.2. Estimation Models

The key dependent variable, SATO, is an interval scale variable. Therefore, we used the ordinary least squares (OLS) estimation method to estimate overall satisfaction models. The main OLS specification is as follows:

$$Yi = \beta\, Xi + \epsilon \qquad\qquad (1)$$

Where, Yi is the dependent variable, Xi is a set of explanatory variables, β is a vector of parameters and ϵ are disturbances associated with each observation.

3.6. Results

Table 10 provides parameter estimates of customer satisfaction models. In Column 1 of Table 10, we report the results of the direct effects model with SATO as dependent variable, and individual service exchanges (e.g., SATCONN, SATVA, SATCUST, SATSALE, and SATBILAC) as independent variables; and test hypotheses H1a, H1b, H1c, H1d and H1e. Next, we included two interaction terms SATCONN X SATVA and SATCONN X SATCUST in the models to test hypotheses H2a and H2b; estimation results are in Column 2 of Table 10.

To compare the coefficients of the moderating terms SATCONN X SATVA and SATCONN X SATCUST across different categories of providers (i.e., to test hypotheses H3a, H3b, H3c and H3d); we included three way interaction terms one at a time. For instance, by including SATCONN X SATVA X GLOBAL in the model, we compare whether SATCONN X SATVA differs across global and local providers (Column 3 of Table 10). Similarly, Column 6 includes the three way intercation term SATCONN X SATCUST X PUBLIC to compare moderating effects of SATCONN X SATCUST across public and private providers. Finally, we model how the moderating effects SATCONN X SATVA and SATCONN X SATCUST vary with operating and capital investment ratio; by including SATCONN X SATVA X OPCAP_R and SATCONN X SATCUST X OPCAP_R in the models, resepectively. We report these results in Columns 7 and 8 of Table 10.

We find support for the hypotheses H1a, H1b, H1c, H1d and H1e. The estimated coefficients of satisfaction with connectivity (SATCONN) (Column 1, Table 10, $\beta=0.267$, $p<0.01$), satisfaction with value added services (SATVA) (Column 1, Table 10, $\beta=0.138$, $p<0.01$), satisfaction with customer care (SATCUST) (Column 1, Table 10, $\beta=0.177$ $p<0.01$), satisfaction with presale and sale process (SATSALE) (Column 1, Table 10, $\beta=0.125$, $p<0.01$), and satisfaction with billing process (SATBILAC) (Column 1, Table 10, $\beta=0.168$, $p<0.01$) are all positive and highly significant in the model. The comparison of coefficients across the independent variables shows that satisfaction with core service ($\beta=0.267$ for SATCONN) has the highest magnitude, followed by customer care ($\beta=0.177$ for

SATCUST), indicating the relative high importance of core service and customer care on customer satisfaction.

We find support for hypotheses H2a and H2b. In the service augmentation interaction model (see Column 2, Table 10), the estimated coefficient of the interaction term between SATCONN and SATVA is negative and highly significant (Column 2, Table 10, β = -0.058, p<0.01), and the estimated coefficient of the interaction term between SATCONN and SATCUST is positive and significant (Column 2, Table 10, β = 0.029, p<0.1). The negative interaction effect supports the theorized substitution effect of value added service (SATVA) on the core service of connectivity (SATCONN), and the positive interaction effect implies a complementary effect of customer care (SATCUST) on connectivity (SATCONN) (see Figures 3 and 4 for the interaction plots). From the interaction plots the substitution effect is clearly discernible. At high levels of satisfaction with VAS, the association between satisfaction with the core service and overall customer satisfaction becomes insignificant. With respect to the complementary effect of customer care, we also see that for higher levels of satisfaction with customer care, the association between satisfaction with the core service and overall customer satisfaction is amplified.

Columns 3 to 6 of Table 10 provide results for the service augmentation interaction models differentiated by provider characteristics (e.g., global, local, public and private providers). As noted earlier, to compare the coefficients of the substitution effects of value added service across global and local providers, we included an interaction term SATCONN X SATVA X GLOBAL in the service

augmetnation model. We find that the intearction term SATCONN X SATVA X GLOBAL is marginally significant and negative (Column 3, Table 10, β = -0.007, p<0.1), indicating that the substitution effect of SATCONN and SATVA is higher for global providers than local providers (H3a). Similarly, to compare the coefficients of the complementary effects of customer care across global and local providers, we included an interaction term SATCONN X SATCUST X GLOBAL in the service augmentation model. We find that the intearction term SATCONN X SATCUST X GLOBAL is significant and positive (Column 4, Table 10, β = 0.056, p<0.05), indicating that the coefficients are significantly different. An inspection of coefficients reveals that the positive interaction effect of SATCONN and SATCUST is higher for global providers than local providers, thereby supporting hypothesis H3c.

To test hypothesis H3b related to differences in the substitution effects of value added service across public and private providers we included the intearction term SATCONN X SATVA X PUBLIC. The coefficient of the 3-way interaction is marginally significant and positive (Column 5, Table 10, β = 0.064, p<0.1). Thus, we find some support for the association predicted in H3b, that the substitution effect of SATCONN and SATVA is higher for private providers than public providers. Furthermore, to compare the coefficients of the complementary effects of customer care across public and private providers, we included the interaction term SATCONN X SATCUST X PUBLIC in the service augmentation model. Results show that the intearction term SATCONN X SATCUST X PUBLIC is not significant (Column 6, Table 10, β = -0.025). Thus, we do not find support for hypothesis H3d.

Columns 7 and 8 of Table 10 provide results for the interaction models differentiated by providers' opex to capex investment ratio. To test hypotheses H4a, we included the interaction term SATCONN X SATVA X OPCAP_R in the service augmentation model. We find that the inteaction term SATCONN X SATVA X OPCAP_R is significant and negative (Column 7, Table 10, β = -0.092, p<0.01), indicating that as the opex and capex ratio increases, the substitution effect of value added service on the relationship between core service and customer satisfaction decreases. This result supports hypothesis H4a. For hypothesis H4b, we included the interaction term SATCONN X SATCUST X OPCAP_R in the service augmentation model, and find that the coefficient is positive and significant (Column 8, Table 10, β = 0.016, p<0.05). This result indicates that with increasing operating investments in proportion to capital investments, the complementary effect of customer care on the relationship between core service and customer satisfaction increases, supporting hypothesis H4b.

We tested for multi-collinearity by computing condition indices for all estimation models. The highest variance inflation factor (VIF) was 2.07 in the direct effect models, confirming that multicollinearity is not a serious concern. The variables are mean-centered in the interaction models. The mean VIF was less than 2.0 in the interaction models after mean centering the variables, further mitigating the threat of multicollinearity. The results are also similar in the interaction models with centered and non-centered independent variables. Because the dependent and independent variables came from the same survey instrument, we conducted Harman's one-factor test to assess the sensitivity of our results to common method

bias. The factor analysis for key variables yielded multiple factors, some with eigen-values exceeding one. Because no single factor emerged dominant in accounting for most of the variance, common method variance does not appear to be a serious problem. In addition, the impact of method variance was tested by creating one marker variable (with all indicators) and linking it to both independent and dependent variables. The impact of this method variable is insignificant which suggests that common method bias should not be problematic in this study. Finally, to account for multiple observations from the same provider, we checked the estimated coefficients with cluster adjusted standard errors of the models, to consider adjustments for within-cluster correlation (Wooldridge 2002). The results with or without cluster adjusted standard errors remain substantively similar.

3.7. Discussion

3.7.1. Findings and Contributions

The goal of this study was to examine how two dimensions of IT enabled service augmentation, i.e., value added service and customer care, interplay with core services to influence overall customer satisfaction. Along with the direct effects of the three sets of service exchanges, core, augmented and peripheral, we argued for interactive effects of service augmentation; and proposed hypotheses for a substitutive effect for VAS and a complementary effect for customer care on the linkage between core service and customer satisfaction. Our study was conducted in BOP markets that are not only of growing global importance, but are also strategically challenging for providers due to the hyper-competition and high

customer churn that characterizes them. Specific to the BOP market context, we argued that the interactive effect of service augmentation is further differentiated by provider characteristics and contingent upon the provider's investment strategy.

In terms of direct effects, we find that three sets of service exchanges, core, augmented and peripheral have a positive and cumulative effect on the overall customer satisfaction with cell phone service, with the core service exhibiting the strongest association. These findings are consistent with prior studies that have examined overall customer satisfaction as an outcome of satisfaction with different aspects of service, such as in the context of airlines services (Anderson et al. 2008), and financial services (Krishnan et al. 1999). In addition, these findings support the widely held belief that a firm's core service is highly important, but also underscores that other service exchanges cannot be ignored for their role in customer satisfaction.

We find that satisfaction with value added service has a substitutive effect on the relationship between core service satisfaction and overall customer satisfaction, while customer care has a complementary effect. In other words, value added services may offset the satisfaction derived from core services, especially when they are not aligned to enhance customer satisfaction. In constrast, the customer-oriented focus of customer care would enhance the effect of the core service on overall customer satisfaction. With respect to provider characteristics, we find that VAS has a higher substitution effect in the case of global providers than local providers. These findings suggest that while global providers may be better equipped financially and experientially to offer VAS, local providers may have an advantage due to deeper understanding of the local institutional contexts. Similarly, the finding that VAS has a

higher substitution effect in the case of private providers than public providers, suggests that aggressive customer acquisition, by providing a number of VAS, may not be effective for customer satisfaction in the institutional context of BOP markets.

We also find that customer care complements the effect of core service satisfaction on overall customer satisfaction in the case of global and private providers, but not in the case of local and public providers. These findings indicate the relative lack of success that local and public providers experience in focusing customer care to support core service delivery. In addition, we find that with increase in operating investments in proportion to capital investments, the substitution effect of VAS on the relationship between core service and customer satisfaction decreases, and the complementary effect of customer care on the relationship between core service and customer satisfaction increases. These findings imply that providers can develop an investment strategy in terms of proportional allocations towards capital and operating investments, to mitigate the substitution effect of VAS, or to improve the complementary effects of customer care on overall customer satisfaction.

This study makes four key contributions. First, we extend prior literature that suggests that augmented service offerings play a significant role in customer satisfaction (Grönroos 1990), by empirically validating the direct significance and moderating effects of two dimensions of service augmentation, i.e., VAS and customer care, on overall customer satisfaction. In examining the relative influence of service augmentation on overall customer satisfaction, the study contributes to the existing literature that has established linkage between customer service parameters

(Ramasubbu et al. 2008), and service dimensions (Anderson et al. 2008; Krishnan et al. 1999) to influence overall customer satisfaction.

Second, this study contributes to emerging research that suggests that measuring granular levels of service satisfaction provides a richer explanation of the differences of performance across different providers (Butcher et al. 2003). We contribute to this stream of literature by measuring and examining how the two dimension of service augmentation differ across different categories of providers (e.g., local, global; and private, public) in the context of cell phone services. Third, the findings complement the emerging literature on service dominant logic; in identifying how a dominant additional value based service can contribute towards value creation, in a low-tariff based service setting such as the low-ARPU based cell phone service. Finally, we extend existing discussions in the information systems literature on service management strategy in the context of digitized services in BOP markets, and how different institutional factors and investment strategies play a role towards service differentiation in delivering digitized services (Rai and Sambamurthy 2006).

3.7.2. Limitations and Implications for Research

We acknowledge limitations of the study that future research should seek to overcome. First, because of data limitations and the use of a cross-sectional design, our results are associational in nature. Longitudinal data across a number of years can help to determine the causal effect of service augmentation on customer satisfaction. Second, the empirical analysis was conducted in the context of one

specific IT enabled service that may limit the generalizability of the results of the study to other contexts. Third, this study is limited to exploring the effects of two components of service augmentation on customer satisfaction that should motivate future studies to seek more nuanced factors related to service augmentation, such as the relative importance of entertainment, information or exchange related value added services, or personalized and automated customer care response systems on customer satisfaction.

3.7.3. Managerial Implications

Three managerial implications follow from this study. First, the findings that the core, peripheral and augmented services have direct influence on overall customer satisfaction underscore the need for managers to focus on all dimensions of their service offerings, rather than an exclusive focus on the core service or VAS. While the core service is doubtless important, ignoring the quality of augmented services might lead to a higher degree of customer dissatisfaction and eventually high attrition rates. Second, the negative moderating effect of VAS, and a positive moderating effect of customer care on the core service-customer satisfaction linkage should motivate managers to plan and strategize the provision of different augmented service offerings.

Third, provider characteristics with respect to being a global and local firm, or a private or public firm, have a bearing on the customers' evaluation of the quality of services. This is indicated by the differential influence of service augmentation for different categories of providers, and implies that providers need to carefully consider their service bundle in the context of their own characteristics. Finally, investment

strategy plays an important role in offsetting the substitution or complementary effects of service augmentation in the BOP markets. Overall, our findings imply that mangers need to consider their positioning in a market, contextual and institutional factors, and practical implementation issues before offering a set of value added services in a market.

3.8. Conclusion

In conclusion, this study provides one of the first empirical tests to explore how two components of service augmentation- value added service and customer care, influence customer satisfaction with cell phone services. Our theoretical conceptualization is grounded in the service management literature, specifically in the service dominant logic conceptualization. We find that along with the direct effects of the components of service augmentation there is a negative moderation effect of value added service, and a positive moderation effect of customer care on the core service-customer satisfaction linkage. Moreover, we find that the moderating effects of service augmentation on core service are contingent on the provider characteristics and investment strategies. The study contributes to the literature that examines the importance of various service dimensions in affecting customer satisfaction.

3.9. Figures and Tables for Essay II

Figure 2. Conceptual Model of Service Augmentation and Customer Satisfaction in
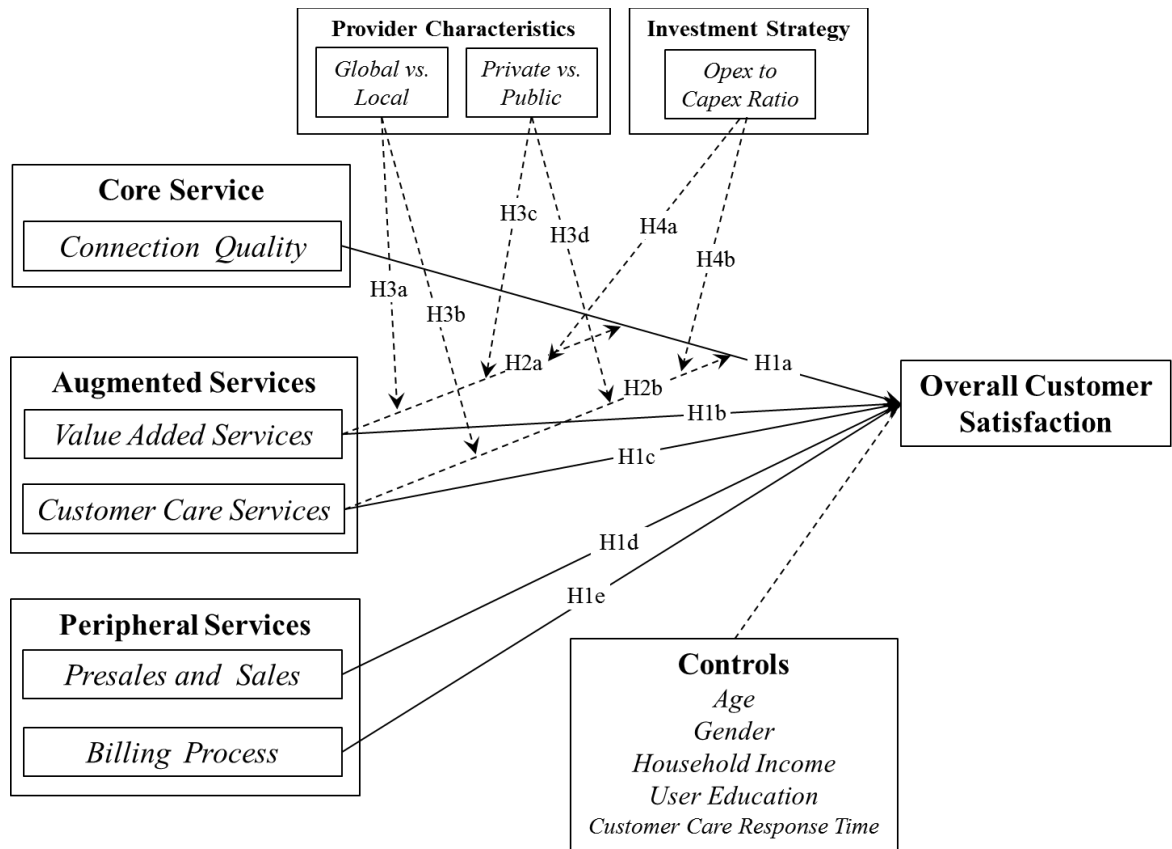BOP Markets

Figure 3. Interaction Plot, Satisfaction with Core Service and Satisfaction
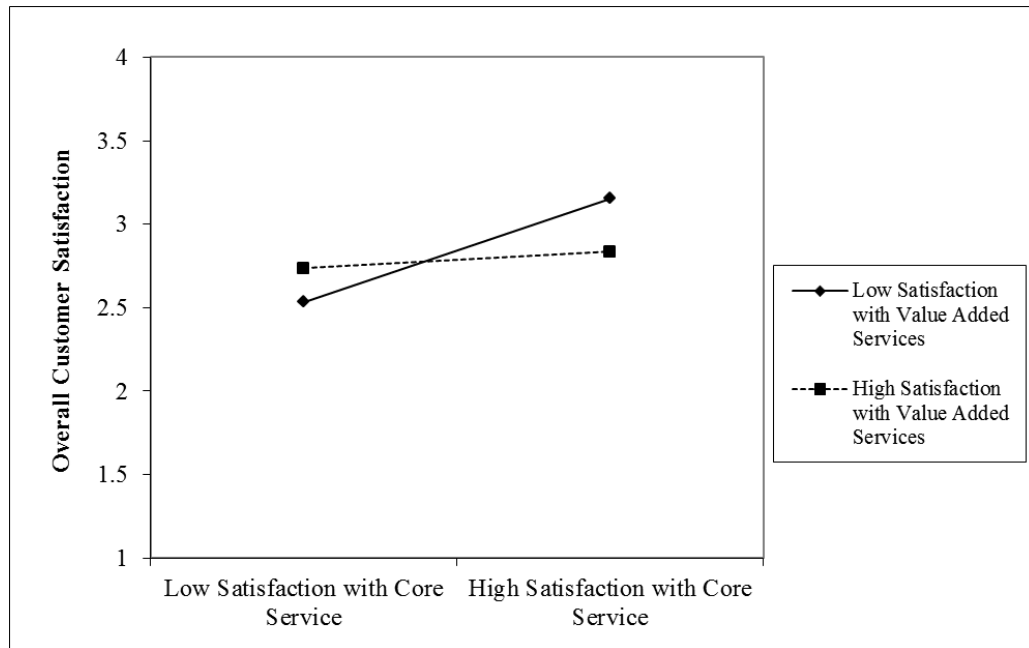with Value Added Services

Figure 4. Interaction Plot, Satisfaction with Core Service and Satisfaction
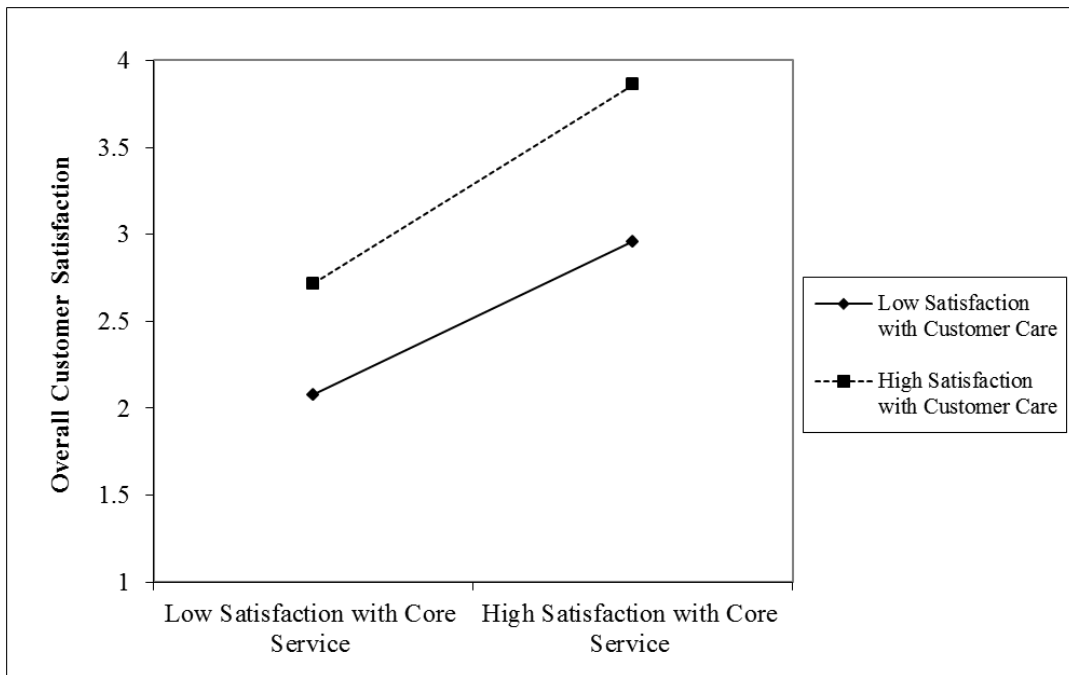with Customer Care

Table 8: Description of Variables for Essay II

Variable	Description
SATO	Overall customer satisfaction with the service provider
SATCONN	Satisfaction with the core service of the cell phone service (connection quality)
SATVA	Satisfaction with value added services
SATCUST	Satisfaction with customer care of the service provider
SATSALE	Satisfaction with presale and sale process
SATBILAC	Satisfaction with billing process of the service provider
AGE	Age of the cell phone user
GENDER	Gender (male=1, female=0)
HH_INC	Monthly household income in thousands of local currency of the country, scale: 1=5k, to 8=100 k
USR_EDN	Cell phone user's education, in a scale of 1=no schooling to 7= postgraduate
WTIMECR	Wait time on hold in average minutes before customer response during interactions
GLOBAL	Dummy variable indicating whether global or local provider; global =1, local=0.
PUBLIC	Dummy variable indicating whether public or private provider; public=1, private=0.
OPCAP_R	Ratio of operating expense to capital expense of the provider, calculated from the above two variables, for the year 2006-07.
REVENUE	Revenue of the provider in 10 bn. US dollars, for the year 2006-07.

Table 9: Descriptive Statistics and Correlations amongst Variables for Essay II

	Variable	Obs	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16
1	SATO	3542	3.42	0.67	1	4	1.00														
2	SATCONN	3523	3.33	0.68	1	4	0.56	1.00													
3	SATVA	3452	3.36	0.67	1	4	0.51	0.46	1.00												
4	SATCUST	3505	3.18	0.78	1	4	0.55	0.49	0.49	1.00											
5	SATSALE	3506	3.52	0.60	1	4	0.42	0.38	0.39	0.35	1.00										
6	SATBILAC	3428	3.23	0.86	1	4	0.53	0.38	0.42	0.47	0.37	1.00									
7	AGE	3542	27.45	8.44	13	72	0.02	0.03	0.06	0.01	-0.04	0.06	1.00								
8	GENDER	3542	0.87	0.34	0	1	0.00	0.01	0.01	-0.02	0.01	0.01	-0.03	1.00							
9	HH_INC	3466	3.47	2.07	1	8	-0.02	-0.03	-0.01	-0.07	-0.07	-0.01	0.18	0.02	1.00						
10	USR_EDN	3542	5.70	1.20	1	7	-0.00	-0.02	0.01	-0.04	-0.02	0.02	0.17	0.03	0.25	1.00					
12	WTIMECR	3536	5.87	8.62	1	90	-0.11	-0.08	-0.11	-0.17	-0.04	-0.07	-0.03	0.00	-0.06	-0.06	1.00				
13	GLOBAL	3542	0.43	0.50	0	1	0.03	0.02	0.00	0.00	-0.02	-0.01	-0.02	0.02	0.12	0.06	0.01	1.00			
14	PUBLIC	3542	0.23	0.42	0	1	-0.07	-0.14	-0.06	-0.09	-0.03	-0.03	0.08	-0.03	-0.05	0.02	0.02	-0.11	1.00		
15	OPCAP_R	2565	0.98	0.57	0.23	3.24	0.04	0.03	0.04	0.06	0.04	0.05	0.02	-0.11	-0.05	-0.01	-0.06	0.01	-0.21	1.00	
16	REVENUE	2598	0.014	0.012	0.001	0.08	0.07	0.03	0.09	0.04	0.09	0.10	0.10	-0.14	0.00	0.03	-0.07	-0.27	0.03	0.57	1.00

All correlations greater than 0.10 are statistically significant at $p<0.001$.

Table 10: Estimation Models for Essay II

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Direct Effects	All Providers	Global vs. Local	Global vs. Local	Public vs. Private	Public vs. Private	Opex to Capex	Opex to Capex
Variables	SATO	SATO	SATO	SATO	SATO	SATO	SATO	SATO
SATCONN	**0.267***** **(0.015)**	0.265*** (0.016)	0.267*** (0.018)	0.262*** (0.015)	0.263*** (0.016)	0.262*** (0.016)	0.267*** (0.018)	0.263*** (0.018)
SATVA	**0.138***** **(0.015)**	0.126*** (0.016)	0.123*** (0.018)	0.130*** (0.016)	0.131*** (0.016)	0.129*** (0.016)	0.134*** (0.017)	0.088*** (0.027)
SATCUST	**0.177***** **(0.013)**	0.184*** (0.013)	0.172*** (0.015)	0.182*** (0.013)	0.182*** (0.013)	0.181*** (0.013)	0.177*** (0.015)	0.177*** (0.015)
SATSALE	**0.125***** **(0.016)**	0.123*** (0.016)	0.128*** (0.018)	0.127*** (0.016)	0.128*** (0.016)	0.127*** (0.016)	0.130*** (0.018)	0.129*** (0.018)
SATBILAC	**0.168***** **(0.011)**	0.168*** (0.011)	0.167*** (0.013)	0.171*** (0.011)	0.171*** (0.011)	0.170*** (0.011)	0.165*** (0.013)	0.166*** (0.013)
SATCONN X SATVA		**-0.058***** **(0.019)**	-0.073*** (0.022)	-0.057*** (0.019)	-0.075*** (0.021)	-0.059*** (0.019)	0.025 (0.037)	-0.077*** (0.023)
SATCONN X SATCUST		**0.029*** **(0.017)**	0.041** (0.020)	0.009 (0.020)	0.030* (0.017)	0.040** (0.020)	0.037* (0.020)	0.033* (0.020)
SATCONN X SATVA X GLOBAL			**-0.007*** **(0.004)**					
SATCONN X SATCUST X GLOBAL				**0.056**** **(0.027)**				
SATCONN X SATVA X PUBLIC					**0.064*** **(0.033)**			
SATCONN X SATCUST X PUBLIC						**-0.025** **(0.027)**		
SATCONN X SATVA X OPCAP_R							**-0.092***** **(0.028)**	
SATCONN X SATCUST X OPCAP_R								**0.016**** **(0.007)**
AGE	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
GENDER	0.019 (0.024)	0.017 (0.024)	0.022 (0.027)	0.006 (0.024)	0.008 (0.024)	0.007 (0.024)	0.017 (0.027)	0.017 (0.027)
HH_INC	0.004 (0.004)	0.004 (0.004)	0.004 (0.004)	0.003 (0.004)	0.004 (0.004)	0.004 (0.004)	0.005 (0.004)	0.005 (0.004)
USR_EDN	0.004 (0.007)	0.004 (0.007)	0.010 (0.008)	0.003 (0.007)	0.003 (0.007)	0.002 (0.007)	0.010 (0.008)	0.010 (0.008)
WTIMECR	-0.073 (0.058)	-0.063 (0.058)	-0.070 (0.067)	-0.056 (0.057)	-0.049 (0.057)	-0.050 (0.057)	-0.069 (0.067)	-0.070 (0.067)
GLOBAL			0.023 (0.037)	0.011 (0.018)				
PUBLIC					-0.015 (0.021)	0.006 (0.021)		
OPCAP_R							0.005 (0.020)	-0.014 (0.019)
REVENUE							0.464 (0.899)	0.501 (0.901)
Constant	0.515*** (0.080)	3.423*** (0.052)	3.296*** (0.061)	3.325*** (0.049)	3.425*** (0.049)	3.426*** (0.049)	3.350*** (0.061)	3.376*** (0.061)
Observations	3,263	3,263	2,379	2,379	3,263	3,263	2,350	2,350
R-squared	0.514	0.515	0.528	0.514	0.513	0.513	0.526	0.524
Adj. R-squared	0.512	0.513	0.525	0.511	0.511	0.511	0.522	0.521
F stat.	214.57***	191.66***	176.31***	244.88***	244.44***	244.02***	172.34***	171.55***

Standard errors in parentheses; Models 1 and 2 include country dummies;
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Survey Questionnaire and Coding Scheme for Variables for Essay II

Variable	Survey Questions/Data and Coding
SATO	Overall customer satisfaction with the service provider Question: At an overall level how satisfied are you with your current mobile service provider? Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied.
SATCONN	Satisfaction with the core service (connection) of cell phone services Questions: How satisfied are you with: (1) overall network coverage & accessibility across city/ town/ state and less network down time, (2) strength of connection & calls not dropping (outdoor/ in building/ in vehicle), (3) voice quality (e.g., cross connection / humming / noise, etc.). Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied. Cronbach's alpha = 0.81
SATVA	Satisfaction with the value added services Questions: How satisfied are you with: (1) time taken for activation of value added services (e.g., Roaming/STD/ISD/ Voice Mail), and (2) relevance of value added services on offer (e.g., SMS, clip, call forward/ call divert/ email/ ring tone/ caller tune etc.). Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied. Cronbach's alpha = 0.70
SATCUST	Satisfaction with customer care of the service provider Questions: How satisfied are you with: (1) accessibility of the customer care representative (pre-recorded

	voice response menu, number and clarity of choices, time taken to speak to a representative), (2) time taken and the appropriateness of the solution provided to resolve the issues. (3) the ability and courtesy shown by customer care representative to understand and deal with your issues Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied. Cronbach's alpha = 0.85
SATSALE	Satisfaction with presale and sale process Questions: How satisfied are you with, (1) the ease of locating a dealer to get a pre-paid connection/ re-charge coupons, (2) getting the desired denomination of re-charge/ top-ups coupons. Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied. Cronbach's alpha = 0.73
SATBILAC	Satisfaction with the billing process Questions: How satisfied are you with: (1) the accuracy and integrity of the operator in deducting money for the calls you made. Scale: 1=very dissatisfied, 2=somewhat dissatisfied, 3=somewhat satisfied, 4=very satisfied.
AGE	Age of the respondent.
GENDER	Gender (male=1, female=0).
HH_INC	Monthly household income in thousands of local currency. Coding: 1=less than 5k, 2=5-10 k, 3=10-20 k, 4=20-30 k, 5=30-50 k, 6=50-75 k, 7=75-100 k, 8=more than 100 k. This was a bracketed variable with ranges, and we converted the bracketed variable to a

	continuous one by using end or mid-point values appropriately.
USR_EDN	User's education. Coding: 1=no schooling, 2=up to 4 years of schooling, 3= 5-9 years of schooling 4=up to 12 years, high school level of schooling, 5=some college, 6=graduate or post-graduate level of education in general stream, 7= graduate or postgraduate level of education in professional stream of education.
WTIMECR	Average wait time on hold in minutes before customer response. Question: What is the average waiting time (in minutes) for which you have to hold the phone and wait before you are actually been able to speak to the customer care representative.
Provider characteristics data, collected from publicly available reports.	
Provider Characteristics	Distribution of global, local, private, public, and total providers in countries: India : global=5, local=8, private=1, public=2, total=13 Pakistan : global=5, local=2, private=6, public=1, total=7 Bangladesh : global=3, local=2, private=4, public=1, total =5 Sri Lanka : global=3, local=1, private=3, public=1, total=4 Nepal : global=1, local=1, private=1, public=1, total=2 Bhutan : global=0, local=1, private=0, public=1, total=1 Maldives : global=2, local=0, private=2, public=0, total=2
Provider financial data, collected from TeleGeography reports.	
CAPEX	Capital expense of the provider, for the year 2006-07.
OPEX	Operating expense of the provider, for the year 2006-07.
OPCAP_R	Ratio of operating expense to capital expense of the provider, calculated from the above two variables, for the year 2006-07.
REVENUE	Revenue of the provider in 10 bn. US dollars.

Chapter 4: Epilogue

IT enabled service innovations are creating value for businesses in several ways to conceive, structure, implement, offer, manage, and augment services and service capabilities. The impact and value potential of IT enabled service innovations vary from transforming business processes, to manage the complexities involved with the customer centric solutions, to enable inter-firm integration, and to provide unique solutions. However, organizations face challenges to assimilate, implement and integrate the IT enabled service innovations with their organizations. Managers face difficulties in execution of strategies to be effective in the context of IT enabled service innovations. In this regard, this dissertation is focused on understanding the design of business operations and strategy to leverage service innovations. Each study of this dissertation make contributions to the information systems and strategy literature in exploring the factors associated with firm performance and success in the context of IT enabled service innovations.

The first study establishes the importance of digital business models for sustainability. Specifically, this study emphasizes on the importance of core services on sustainability of HIEs; and suggests that as an HIE progresses, foundational services are more influential than vendor driven or advanced services towards sustainability. Furthermore, the study finds that transaction-based revenue models influence sustainability at later stages; whereas subscription-based revenue models help in early stages of HIE growth. These findings inform HIE managers to design and evolve appropriate digital business models that can be helpful to achieve sustainability. The essay contributes to existing information system and strategy

literature in explicating the comparative effects of different core services, and distinct revenue models on sustainability.

The second study examines how two dimensions of IT enabled service augmentation, i.e., value added service and customer care, interplay with core services to influence overall customer satisfaction. Along with the direct effects of the three sets of service exchanges, core, augmented and peripheral, the empirical analysis shows a substitutive effect for value added service and a complementary effect for customer care on the linkage between core service and customer satisfaction. The study was conducted in base-of-the-pyramid (BOP) markets that are of not only growing global importance, but also strategically challenging for providers due to the hyper-competition and high customer churn that characterizes them. Specific to the BOP market context, the findings suggest that interactive effects of two dimensions of service augmentation on core service is further differentiated by provider characteristics, and are contingent upon the provider's investment strategy. The second study contributes to emerging research that suggests that measuring granular levels of service satisfaction provides a richer explanation of the differences of performance across different providers.

Overall, the two studies in this dissertation investigate salient factors that should receive requisite attention from managers to effectively manage and profit from IT enabled service innovations. Thus, the dissertation has research and practice implications to gain an understanding of the appropriate strategies to increase firm performance for IT enabled service innovations.

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